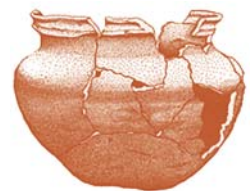


# Redstone Arsenal World War II Resource Study

Redstone Arsenal, Alabama



**New South Associates**  
6150 East Ponce de Leon Avenue  
Stone Mountain, Georgia 30083

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Contract Number DACW21-99-D0004

### **Final**

Report submitted to:

U.S. Army Corps of Engineers  
Savannah District  
100 W. Oglethorpe Avenue  
Savannah, GA 31402-0889

Report prepared by:

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April 1, 2003

## ABSTRACT

This report is a combination of two documents: Panamerican, Inc.'s, *Architectural Assessment of the World War II Military and Civilian Works, U.S. Army Aviation and Missile Command, Redstone Arsenal, Madison County, Alabama*, January 1998 and New South Associates, Inc., *Redstone Arsenal World War II Resource Study*, July 2001. This combined report details the history and architecture of the three WWII installations located on what is now the Redstone Arsenal. They include the Huntsville Arsenal, Redstone Arsenal, and the Gulf Chemical Warfare Depot. Recommendations were made regarding NRHP eligibility for the remaining WWII buildings on the post. There are presently five districts recommended as eligible to the NRHP under the WWII context. They include the Huntsville Arsenal Carbonyl Iron Unit Historic District, Huntsville Arsenal Mustard Gas Historic District, Redstone Arsenal Line 3 Historic District, Redstone Arsenal Line 2 Historic District and the Gulf Chemical Warfare Depot—Igloo Area 2 Historic District. It is also recommended that the Harris House (8012), located on the former GCWD, be considered eligible to the NRHP as an individual building.

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## I. INTRODUCTION

This report is a combination of two documents related to the World War II history of Redstone Arsenal. Panamerican Inc. conducted an intensive architectural survey of the installation and created the first report in 1998 based on their findings (Nolte 1998). They identified potentially significant resources related to Redstone Arsenal's World War II history and produced a historical context. New South Associates (NSA) expanded the 1998 report and made definitive assessments regarding National Register of Historic Places (NRHP) eligibility of the remaining World War II resources at the Redstone Arsenal (Langdale 2001). To make the individual reports useful to the staff at the Directorate of Environmental Management (DEM), the U.S. Army Corps of Engineers, Savannah District, requested that New South Associates combine the two reports through a delivery order issued under Contract No. DACW21-99-D-0004.

The Redstone Arsenal is an U.S. Army installation located in Madison County in north central Alabama. The installation was originally built as three different, yet closely integrated, complexes beginning in 1941. They are: the Huntsville Arsenal which was operated by the Army's Chemical Warfare Service (CWS) during World War II; the Redstone Ordnance Plant, which was renamed the Redstone Arsenal in February 1943, and managed by the Army Ordnance Department; and the Gulf Chemical Warfare Depot, which was responsible for receiving, storing, and shipping CWS materiel.

The three separate installations were subsumed into one ordnance facility in 1949 when the Army officially reactivated Redstone as the Ordnance Rocket Center. The 1,840 acre George C. Marshall Space Flight Center is located in the center of the Redstone Arsenal; the flight center was first leased to NASA in 1960. Today the remainder of the Redstone Arsenal serves as the U.S. Army Aviation and Missile Command (AMCOM) (Redstone Arsenal website; [www.redstone.army.mil](http://www.redstone.army.mil)).

This report includes a historic overview of the Huntsville area and the three installations as well as architectural descriptions of the WWII buildings and structures. It also includes discussions of NRHP eligibility. Buildings have been placed into groups based on their use at the time of their construction. Appendix A is a complete list of all WWII buildings remaining at the Redstone Arsenal as of 1995 when Panamerican, Inc. began their fieldwork. It also includes the NRHP eligibility recommendations for each property.

## II. PREVIOUS RESEARCH

Several studies of the Redstone Arsenal's historic World War II built environment have occurred in the past two decades. The most significant include a 1984 report by Building Technology, Inc. which documented all buildings and structures constructed before 1945 "except basic utilitarian structures of no architectural, historical, or technological interest" (Building Technology 1984:6). This report also examined a representative group of post-1945 buildings and structures. Included in this study is a historical overview of the Redstone Arsenal along with HABS/HAER inventory cards for forty individual properties and a set of recommendations for future management of these resources.

The most recent and comprehensive study of the Redstone Arsenal's World War II structures is the 1998 Panamerican, Inc. report mentioned above (Nolte 1998) which recorded 850 buildings with construction dates between 1941 and 1946. Fieldwork was undertaken during the winter of 1995 and spring of 1996. The goal of this survey was to identify potentially historic WWII military and civilian-created structures and make recommendations as to their NRHP status. Each resource was photographed and documented with Alabama State Historic Preservation Office (ALSHPO) approved survey forms. The final report includes a detailed history of the Arsenal as well as descriptions of production lines and individual buildings and preliminary recommendations for NRHP status.

Upon reviewing the 1998 Panamerican, Inc. report, the ALSHPO requested more information about a number of resources and building types. The Directorate of Environmental Management at the Redstone Arsenal also disagreed with several of the NRHP recommendations and asked for definitive assessments about many of the buildings which were listed as being "potentially" eligible to the NRHP.

New South Associates, Inc. was contracted in August 1999 to reassess the NRHP eligibility of the World War II buildings and provide answers to the questions posed by the state of Alabama and the Directorate of Environmental Management. New South Associates' report, submitted in July 2001 (Langdale 2001), added more historical information and proposed four NRHP districts: Huntsville Arsenal Carbonyl Iron Unit Historic District, Huntsville Arsenal Mustard Gas Historic District, Redstone Arsenal Line 3 Historic District, and the Gulf Chemical Warfare Depot—Igloo Area 2 Historic District. The NSA report also recommended that the Harris House (8012) be considered eligible to the NRHP under Criteria A, C, and possibly D as an example of an agricultural property that evolved during the pre-federal period. The ALSHPO concurred with these recommendations per letter to the Directorate of Environmental Management on May 18, 2001.

### III. METHODS

Because this report is derived from two previous documents written by different contractors, the methods employed by each author are discussed separately.

#### FIELD METHODS

##### Panamerican, Inc.

Panamerican, Inc. conducted an intensive architectural survey and detailed historical research beginning in 1995. During this survey, they identified and inspected 850 buildings with construction dates between 1941 and 1946. Buildings to be surveyed were chosen based on the Redstone Arsenal's Real Estate List that provided dates of construction as well as square footages and other information. Numerous buildings did not appear on the list, and the architectural historian in charge of the project decided to add them after personally inspecting the structures and making an informed decision as to their age. The collection of field data involved photographing the buildings, compiling historical information, and completing a field survey form. The information recorded on forms include details such as date of construction, building form, materials, construction methods, stylistic elements, measurements, and structure history. All field data was crosschecked with Redstone Arsenal's Real Estate Files, existing blueprints, official histories, records, and closing reports.

The identified structures were located by numerical sequence on the Redstone Arsenal's "General Site Map: Master Plan Basic Information Maps" within clusters relating to historic function and accessibility. This seventeen map series showed the post's road network, topographic features, and building locations and numbers for all structures located on the post in October of 1986. Field efforts concentrated on documenting all the structures located in these obvious road networks and historically oriented clusters. After all the buildings in each identified area had been recorded, the survey team then moved to the next grid map area.

Initial emphasis was placed upon the structures that were listed on the "Buildings Demolitions" list provided by the Redstone Arsenal's Cultural Resource Office (Real Estate Division 1995). Areas with limited access due to national security concerns were given high priority.

After a structure was identified and located, the survey team began the documentation process by completing the structure field forms. Upon completion of the field forms, the structure was photographed and measured. All forms, photographic logs, and drawings were cross-referenced to ensure data continuity.

In areas of high national security concerns, each building manager was contacted before the documentation process began. Some buildings and entire areas (such as the North and South Plants) required that the team be escorted by post or contractor

personnel. Several structures were of such high security that a post-provided escort had to approve the view and image through the camera before photographs could be taken of that particular area. The post military police also were kept well informed of the survey team's mission and daily location.

#### New South Associates

As the field survey work conducted by Panamerican was satisfactory and relatively current, New South Associates did not record individual buildings, but simply conducted a windshield survey of most of them, paying particular attention to those for which the ALSHPO and the DEM had specific concerns. The New South Associates team also noted buildings that had been demolished or altered. No new survey forms were completed and no changes were made to them directly, although the original use of a few of the structures was mislabeled and corrected in the New South Associates report. For the most part, however, the survey information and photographs gathered by Panamerican, Inc. were found to be detailed and very good.

### HISTORICAL RESEARCH

#### Panamerican, Inc.

To develop a historic overview, various sources were consulted including: secondary histories of WWII, the U.S. military, and Huntsville; government documents; and blueprints, real property records, historic maps, and miscellaneous files available at the Redstone Arsenal.

An attempt was made to place Redstone Arsenal within a state historical context. While Alabama does not use a formal context, the U.S. Army Materiel Command (AMC), of which Redstone Arsenal is a part, had a historic context in draft form for WWII facilities when Panamerican, Inc. undertook their project (Cannan et al. 1996). The time period defined for the AMC context is 1940-1946 and begins with the Protective Mobilization of the summer of 1940 and ends August 1945 with the surrender of Japan.

For purposes of organizing the survey and report, Redstone Arsenal was divided into its three WWII posts: Redstone Arsenal, Huntsville Arsenal, and Gulf Chemical Warfare Depot. Each post was then further divided into historic use components such as production lines, administrative areas, and storage facilities. These components are especially important since they continued to guide the functions of the post and its structures after WWII. However, all three installations referred to streets, manufacturing line and plant areas, rail lines, and power plants by number which lends some confusion to the identification of resources. For example, there are Lines 1 and 2 on both Redstone and Huntsville Arsenals, and there are Lines 1 and 2 in all three chemical plants on Huntsville Arsenal. Unfortunately, the production areas and lines acquired no new names after the war and, in the case of Huntsville Arsenal, the actual delineation of the original lines has become blurred. By discussing lines and areas in



the context of their use, perhaps some of this confusion created by repetition of numbers was avoided.

### New South Associates

In an attempt to clarify and bolster the Panamerican report, New South Associates reviewed additional secondary and primary sources at the Redstone Arsenal and at other libraries. They specifically focused on the overall role of chemical weapons, incendiary bombs, and smoke munitions in WWII and how the three installations contributed to that mission. They also sought to insert more social history into the historic overview and gather more detailed information on individual buildings and production lines.

## EVALUATION

Each contractor applied the same standardized set of criteria to assess the National Register of Historic Places eligibility of each of the remaining WWII properties at the Redstone Arsenal.

Potentially significant historic properties include districts, structures, objects, or sites that are at least 50 years old and in this scope of work, are significant to the WWII history of the Redstone Arsenal. To be eligible for inclusion in the NRHP, a historic property must possess a quality of significance in American history, architecture, archaeology, engineering, and culture [that] is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling and association. Sites are evaluated under four Criterion: A, B, C, and D, as outlined in 36CFR Part 60, National Register of Historic Places Nominations by State and Federal Agencies and 36CFR Part 800, Advisory Council on Historic Preservation, Protection of Historic and Cultural Properties. The four criterion are:

- A. Properties that are associated with events that have made a significant contribution to broad patterns of our history
- B. Properties that are associated with lives of persons significant in our past.
- C. Properties that embody the distinctive characteristics of a type, period, or method of construction or that represent the work of a master, or possess high artistic value, or that represent a significant and distinguishable entity whose components may lack individual distinction.
- D. Properties that have yielded, or may be likely to yield, important information in prehistory or history.

The purpose of this report is to evaluate buildings constructed at Redstone Arsenal prior to 1946 under a World War II context. While many of the buildings analyzed were found to be unremarkable WWII properties, they were crucial to the Cold War history of the installation. All buildings constructed prior to 1989 were

evaluated for their Cold War significance in two reports: *Draft of Architectural and Historic Inventory of Buildings and Structures Dating to the Cold War Era (1946-1989) at Redstone Arsenal, Alabama* (Ruth Nichols, TRC Mariah, Inc., 1997) and *Rocket Science: A Historic Context and Assessment of the U.S. Army Cold War Properties 1946-1989, Redstone Arsenal, Alabama* (Kip Wright, Historic Resource Assessments, November 2000). The more recent document recommended that several individual buildings and one district be considered eligible to the NRHP under the Cold War context. The ALSHPO concurred with their findings and also recommended Buildings 110, 111, 112, 114, 116, 118, 4381, 4484, 4488, 4489, 4505, and 4722 eligible to the NRHP per letter dated July 23, 2001. Lauren McCrosky of the U.S. Army Corps of Engineers, Seattle District, made a further assessment of these structures in 2002. After reviewing her work, the ALSHPO rescinded their original concurrence for Building 4722 per letter dated May 30, 2002 stating that the structure has been too altered for NRHP inclusion under Exception G.

## IV. HISTORIC OVERVIEW OF HUNTSVILLE AND MADISON COUNTY

### ENVIRONMENTAL SETTING

Redstone Arsenal is located in Madison County in north central Alabama. It is bordered by the city of Huntsville on the northeast and the Tennessee River on the south and occupies an area of 57.2 square miles.

Madison County is in the Appalachian Plateau. This plateau, which is known as the Cumberland Plateau in Alabama, continues up into Tennessee (Johnston 1930). The areas north of the Tennessee River are known as the Highland Rim. Elevations for the plateau range from 700 feet to around 1,000 feet near the Tennessee River (Fenneman 1938). The Tennessee River forms a major valley feature running east to west through the plateau.

Since the settlement of northern Alabama and the construction of Redstone Arsenal in the 1940s, the local environment has changed a great deal. The construction of the TVA waterway system in the 1930s has resulted in better flood control of the Tennessee River. The backup on local streams from the TVA's lake and dam-oriented efforts has created a marsh/swamp wildlife refuge (Wheeler Wildlife Refuge) that runs through the center of Redstone Arsenal. This refuge has become a fertile breeding ground for many waterfowl species.

Large areas of open pastureland used for hay production and cattle grazing now occupy much of the former fields and forested areas on Redstone Arsenal. Walking trails, golf courses, and building construction with their combined parking lots and walkways have also altered the natural topography. Landscape feature changes such as igloo complexes and the numerous elevated railroad track embankments affect the natural topography in many areas. Timbering operations that harvest and plant pine trees are common on much of Redstone Arsenal. Hardwood forested areas are still present but in ever diminishing sizes and age.

### PRE-FEDERAL PERIOD

Hernando de Soto first explored the middle Tennessee River area in 1540, and encountered only a few American Indian settlements despite the agricultural suitability of the region and varied animal populations. The lack of native settlements in this area is attributed to the prevailing intertribal boundaries and animosities of the three predominate cultures in the region at the time (the Cherokee, Chickasaw, and Creek) (Jackson et al. 1996).

European exploration of the region ceased for almost a century shortly after de Soto's initial investigations. By the time contact was reestablished in the seventeenth

century, the aforementioned tribes all had larger settlements along the banks of the Tennessee. The newly increased presence of European colonists caused greater conflict among the tribes, and a period of warfare and unofficial alliances followed. A five-year war between the Cherokee and the Chickasaw that erupted in 1764 saw the eventual retreat of both tribes from the Tennessee Valley, leaving it virtually uninhabited. The tribal lands were codified in 1786, but the American Indian's possession of these lands was slowly diminished through treaties and purchases.

Illegal squatters made the earliest encroachments on American Indian land in what is now the Madison County/Huntsville area. When Georgia ceded its western lands to the federal government in 1798, even more individuals moved into the area. Between 1790 and 1800, settlers, many of whom were of Scottish and/or English descent, set up farms and trading outposts. They included John Ditto, a trader; Joseph and Isaac Criner, farmers; and Stephen McBroom, an explorer and farmer. In 1805 John Hunt arrived from Tennessee and built a cabin at Big Spring, a pure water spring that flowed into the Tennessee River at an average of 24 million gallons per day. Other settlers soon followed, taking advantage of the area's natural resources and rich farming land.

Madison County, named for James Madison, was created in 1808; a full eleven years before Alabama achieved statehood. When federal land sales began in August 1809, the population already stood at 2,223 whites and 332 blacks. By 1811 Leroy Pope charted the town of Twickenham at the Big Spring, which would eventually be called Huntsville in honor of John Hunt.

In 1817, Congress organized the Alabama Territory and statehood was granted in 1819. The state constitutional convention met in Huntsville, and the town served as the capitol until 1820. Statehood brought more settlers and prosperity to Huntsville. The first bank in Alabama was established here, and plans for toll roads, canals, and railroads created much speculation. Madison County, however, was primarily an agricultural community and its largest investments were in slaves and land. The area's early wealth can be seen in the large number of impressive antebellum structures that still stand. Cotton was truly king in Huntsville, fueling the engine of antebellum expansion and development. The creation of boarding schools, a public library, and newspapers all attested to the wealth and the desire for greater cultural activities within the community.

The Civil War brought a momentary end to the agricultural growth of the area. In 1862 Huntsville was captured and occupied, and the Confederate supply route furnished by the Memphis and Charleston Railroad, was severed. By 1865 the economy was in shambles. The years of Reconstruction were difficult for the area, but by the late nineteenth century, cotton production rebounded with an increase of venture capital primarily from northern sources.

Shortly after the turn of the century, Huntsville experienced a boom in textile mill construction. This unprecedented growth gave Huntsville a greater capacity for processing cotton textiles than any other city in the South at this time. By 1901 mill villages were flourishing and there were 100 textile mills located in Huntsville with more than 500 units of company-owned housing for employees (McCollum and Farrow

1986). The textile industry was bolstered by the thriving cotton gins and the iron works that supplied parts and made repairs to the many looms and gins of northern Alabama. The combination of these industries made the rapid development of the state possible (Lyon 1957). Large progressive cotton farms located on the outskirts of Huntsville owned by families such as the Flemings, Hays, and Buntleys, supplied the vast amounts of cotton required. By 1940 the Madison County's population equaled 66,317 as mill production increased and the textile industry continued to grow (Dooling and Dooling 1980, U.S. Historical Census Browser).

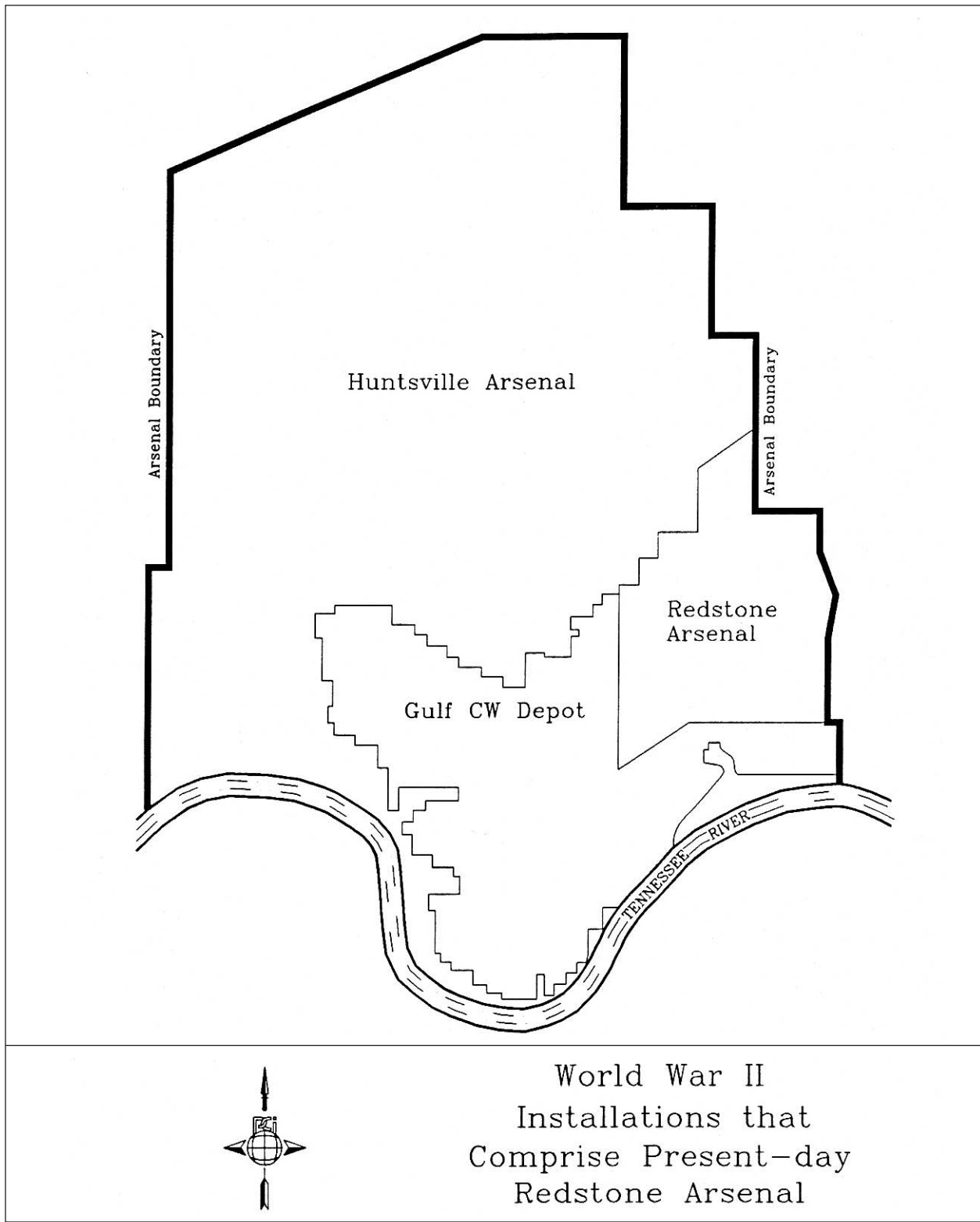
In response to growing world tensions, Congress approved funds in April 1941 for the construction of an additional Army chemical production facility to supplement the Chemical Weapons Service's only chemical manufacturing plant at the Edgewood Arsenal in Maryland. Nine sites located across the nation were reviewed. Maj. Gen. Walter C. Baker, a former Chief of the CWS, first visited Huntsville and sent other officials for additional site research in June 1941. Huntsville was chosen as the location for the CWS arsenal over the other competitors because it possessed 33,000 "reasonably priced" acres, excellent transportation facilities, labor conditions, a power supply from the TVA, operating personnel and raw materials, fuel, water, a good climate and living conditions, and sewage disposal. Congress announced plans for its construction on July 3, 1941. Two other CWS facilities in Pine Bluff, Arkansas and outside Denver, Colorado were also established shortly after Huntsville. All of them were responsible for producing a wide range of toxic chemicals, incendiaries, smoke munitions, and protective clothing. Ground was broken at the Huntsville facility on August 4, 1941 and the first production line began operating on February 28, 1942 (Joiner 1966).

When plans for the construction of the CWS's Huntsville Arsenal were announced, the Army's Ordnance Department was quick to see the advantages of having a shell-loading plant adjacent to a chemical arsenal. In September 1941, appropriations were approved for construction of the new 4,000-acre Redstone Ordnance Plant. Construction began in October 1941 and the first line opened for production in March 1942. Chemicals were made and loaded at Huntsville Arsenal and sent by railroad to the Redstone Ordnance Plant where the final product was assembled. The facility was reorganized, upgraded, and renamed the Redstone Arsenal in January 1943 (Nolte 1998:68).

To store all the ammunition and chemicals produced at the Huntsville and Redstone Arsenals, another facility was needed. The CWS proposed creating a storage depot at the extreme southern end of the Huntsville Arsenal and by February 1942, construction plans were under way. Initially called the Huntsville Depot, the facility's mission was to receive, store, and ship CWS materiel coming from all CWS arsenals, procurement districts, and other depots. This included all types of CWS munitions, bulk chemicals, decontaminating apparatuses, and protective materials. The installation's name was changed to the Gulf Chemical Warfare Depot in July 1943 (Joiner 1966, Nolte 1998:126).

By February 1942, there were three separate, yet closely integrated installations on the outskirts of Huntsville (Figure 1). The complex as a whole manufactured chemicals, processed them into weapons, and then stored them. The two arsenals were

Figure 1  
Layout of WWII Installations



Courtesy of Panamerican Consultants, Inc., 1998

highly successful during the war with Huntsville receiving four Army-Navy “E” awards and Redstone earning five. The Huntsville Arsenal was unique in that it was the sole producer of colored smoke munitions in the country and produced nearly all of the floating smoke pots procured by the Army during the war. The Redstone Arsenal gained recognition for perfecting the technique of the mass production of tetrytol, a highly explosive binary mix used in certain bursters, boosters, and demolition blocks (Redstone Arsenal website).

## REDSTONE IN WORLD WAR II

Huntsville, in some ways, was no different than other towns with a new military installation. The development of the 39,000-acre reservation obviously had a tremendous effect on the surrounding community. The Tennessee Valley Authority (TVA) granted the War Department permission to use 6,990 acres of its land as a military installation. (The TVA, in fact, still retains control over 2,990 acres today while the U.S. Fish and Wildlife Service still administers the 4,000-acre Wheeler National Wildlife Refuge located in the center of the present Redstone Arsenal.) Additional land was obtained from private farms, seventy-six percent of which were owned or tended by African-Americans. The land was comprised of over 300 individually owned tracts. The Army quickly sought title, but allowed owners six months to harvest their crops and find new homes before the military took occupancy. The Farm Security Administration helped find new farms and homes for the displaced residents and offered small grants to help farmers relocate. Still over half of the 550 families made the move without assistance with many finding work at the new military installations. The three installations were constructed on former farms, church yards, cemeteries, and small communities like Mullins Flat, Pond Beat, and Hickory Grove. All together, the Army inherited a diverse inventory of buildings, including more than 500 dwellings, three schools for African-Americans, one white church and eleven black churches, at least 31 cemeteries, and several black lodges (Stephens 1984:107, McCrosky 2002c:2-3).

The realities of constructing such a facility in rural Alabama posed unique challenges to the first commanders of the arsenal and ordnance posts, not the least of which was navigating the rich muddy soil. Locals remember first coming to the post to find work:

Bulldozers had cleared the site of every tree and shrub and blade of grass. Red mud in deep troughs stretched in every direction to barbed wire fences, broken here and there by guard towers. A number of regulation Army barracks had been erected, interconnected by wooden walkways (Stephens 1984:106).

Other obstacles included finding qualified workers. World War II had a profound effect on nearly all aspects of American working life. The number of federal civilian workers quadrupled from 950,000 in 1939 to 3.8 million in 1945 (Jeffries 1996:16). Unemployment fell from 15 percent in 1940 to 5 percent in 1942 and then to 1 percent in 1944. By 1943 there was a nationwide worker shortage resulting in the

introduction of new employees into the mainstream work force who were previously underused in the prewar period (Jeffries 1996:48). With the creation of hundreds of military bases across the country, thousands of factory, industrial, defense, and service workers were needed to sustain the war effort.

In Huntsville, vast numbers of workers were needed to clear the land and construct the necessary buildings. Within a week of choosing the site on July 3, 1941, almost 1,200 men from Huntsville and the surrounding area registered to work (Hughes 1995:2). With the U.S. entry into WWII on December 7, 1941, construction was stepped up and at its peak of construction, more than 12,000 contractor workers were working to complete the Huntsville Arsenal and the Redstone Ordnance Plant (Cagle 1955:30).

After the installations were complete and production plants running, engineers, skilled office personnel, and production line workers were needed. The Huntsville Arsenal first had difficulties finding clerical help and electrical personnel. It was estimated that 95 percent of the available workers in the area were experienced only in agriculture, making the quest for skilled help a great challenge (Hughes 1995:2). This problem was somewhat reduced after the construction contractors finished their work and some of their employees were hired by the government for the needed positions (*History of the Huntsville Arsenal* n.d.:89). Later, the Arsenal had trouble locating individuals with backgrounds in chemistry. To alleviate this problem, the CWS recruited recent graduates of technical schools and colleges in the Southeast and sent them to the Edgewood Arsenal in Maryland for training in munitions and gas manufacturing. The University of Alabama and Auburn University also offered tuition free technical courses and defense training courses beginning in September 1941 for men and women in subjects like accounting, structural design, mechanical and electrical maintenance, and chemistry. As the number of men leaving for combat increased, local women were strongly urged to enroll in these classes. The University of Alabama, in fact, began offering classes in chemical laboratory techniques for women only in April 1942. The Redstone Arsenal had its own Civilian Training Department, but the Huntsville Arsenal did not initiate such a program until August 1944 (Hughes 1995:2, 7).

At the beginning of World War II, most of the U.S. defense workers were men. As the number of enlistees rose, women began to replace them in the workforce. Secretary of War, Henry L. Stimson, announced plans to double the number of women in war jobs in September 1942 (Hughes 1995:2). During the war, the number of employed women in the U.S. rose 50 percent from 12 million to 18 million. By the end of the war, 38 percent of these female workers were employed in factories (Jeffries 1996:95). A larger number of African-Americans also entered the work force during World War II. In 1942, blacks held 3 percent of all defense jobs in the U.S. This figure rose to 8 percent by the end of the war (Jeffries 1996:113).

For the first two years of the Huntsville Arsenal's operation, most of the workers were male, both black and white. Some women worked on the production lines, but none were African-American. Due to the segregation restrictions of the mid-twentieth century South, there were no separate restrooms for black women at first. According to the Army, this prohibited their hiring until the summer of 1943 when the CWS employed the first black women at the Huntsville Arsenal (*History of the Huntsville*



*Arsenal* n.d.:91). Arsenal officials were first opposed to women in the plants because they were not certain of their productivity. Women, however, eventually proved themselves to be competent inspectors, clerks, fork-lift operators, guards, truck drivers, and press operators (Hughes 1995:10). At the incendiary bomb filling plant, women filled bombs, operated spray guns, installed fuses, stenciled, drove lift trucks and ran automated machines. Supervisors found that women could operate the automatic machinery faster than their male counterparts (*History of the Huntsville Arsenal* n.d.: 613). At peak employment in May 1944, 6,707 men and women civilians were employed at the Huntsville Arsenal (Hughes 1995:8).

The Redstone Arsenal, however, never had reservations about hiring women. The Commanding Officer, Major Carroll D. Hudson, hired the first two women in February 1942 and by the end of the year, 40 percent of the workers on the production lines were women. They, in fact, made up 62 percent of the employees in September 1945 (Hughes 1995:9). The first black women, however, were not employed on the Redstone's production lines until April 1944 (Hughes 1995:10). At the Redstone plant the first jobs given to women were for administrative and lighter production tasks, but as the war progressed, they were given minor engineering aid positions which involved testing and inspecting materials, parts, and munitions (Hughes 1995:9). Eventually a move was made toward all women crews which were at first headed by male supervisors, but by 1943, women were supervising their own crews and they were among the most efficient (Hughes 1995:10). A large number of the women at the Redstone and Huntsville Arsenals were older housewives who had never worked outside of the home and many had sons, daughters, and grandsons who were serving in the Armed Forces (Cagle 1955:63). In September 1944, 63 percent of the civilian workers at Redstone were male with 52 percent of them white and 11 percent black. Of the 37 percent women workers, 11 percent were African-American (Hughes 1995:8). At Redstone's peak, 4,500 civilian workers were employed.

Huntsville was a booming city during World War II. In 1942, 15,000 people were employed in the county and by May 1944, 17,000 were employed in manufacturing alone with the total number of jobs available reaching 30,000 (Stephens 1984:112). Approximately 80 percent of the workers came from Limestone and Madison counties and the remaining were from Morgan, Jackson, and Marshall counties (*History of the Huntsville Arsenal* n.d.:86-87). Those who wanted to move to Huntsville had trouble finding inexpensive housing and ways to get to work with poor road conditions and little transportation available (Hughes 1995:2). Locals rented rooms to newcomers, but these filled quickly. Some families were forced to sleep in cars, on the courthouse benches or in Big Spring Park (Stephens 1984:108). Private housing developments were completed just outside of the city center, but they were still over eight miles from the installations and they provided no allowance for low income workers (Cagle 1955:30). To alleviate the severe housing shortage, the government set up trailer parks (Stephens 1984:109). They also constructed 520 family units on land near Farley, Alabama just southeast of the Redstone Ordnance Plant. Redstone Park (for white workers) and Binford Court (for black employees) were completed in early 1943 and occupied exclusively by Huntsville Arsenal and Redstone Arsenal workers (Cagle 1955:30). They remained constantly filled throughout the war (*History of the Huntsville Arsenal* n.d.:93). There were six other government housing projects constructed in Huntsville, but they were privately owned and charged a higher rent (Joiner 1966). The textile factories also

remained in operation producing vast amounts of heavy cotton duck used by the armed forces for tents, tarpaulins, hatch covers, and a host of other articles (Nolte 1998:13).

At the close of the war, most of the workers were no longer needed. The Redstone Arsenal first reduced its workforce in June 1945 when 200 employees (mainly black women) were terminated. By the end of October 1945, all the ordnance lines were shut down. Huntsville Arsenal started reductions in August 1945 and all plants were placed in "standby storage." The Gulf Chemical Warfare Depot was renamed Gulf Chemical Depot on August 2, 1946. It was then abolished on January 15, 1947 and its functions were transferred to Huntsville Arsenal (Nolte 1998:24, Hughes 1995:25).

The social and historical effects of the chemical, smoke, incendiary and bomb filling plants in Huntsville were significant. Many historians concede that the scientists and factory workers were as important to the defeat of the Axis as were its soldiers (Jeffries 1996:43). Wartime technology and fabrication laid the foundation for post war growth in aerospace, electronics, plastics, chemicals, and communications (Jeffries 1996:45). The women and African-Americans who entered the mainstream workforce for the first time set a precedent for American working life for decades to come. The Redstone Arsenal itself certainly had profound implications for the future development of the city of Huntsville and the state of Alabama. Now a center for technical engineering, tourism, and space technology, the economy and character of north Alabama would have been drastically different without the creation of these installations during World War II.

## EARLY COLD WAR MISSION

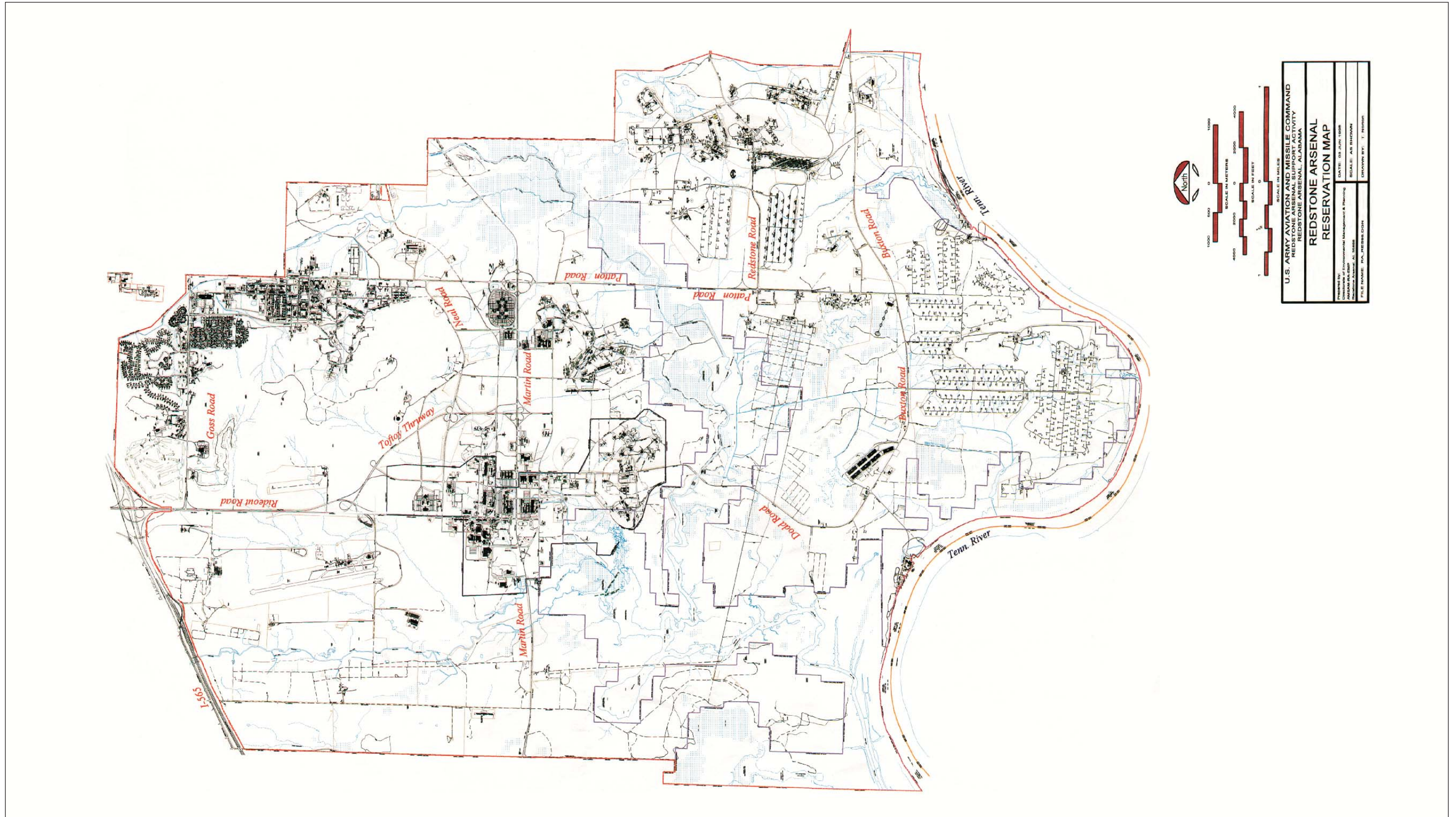
Even though the official activation did not occur until June 1, 1949, the U.S. Army's Chief of Ordnance designated the Redstone Arsenal as the Center for Ordnance Rocket Research and Development in October 1948. The Huntsville Arsenal ceased to exist as a separate installation on June 30, 1949 and it officially became part of the Chemical Division of Redstone Arsenal. Along with its rocket mission, the Redstone Arsenal also continued to produce chemical ammunition from July 1951 to July 1956 (Redstone Arsenal website; [www.redstone.army.mil](http://www.redstone.army.mil)).

Availability of land and expediency were the main reasons for choosing Redstone as the nation's rocket research and development center. The Army felt that the installation could be converted to this new purpose more quickly and cheaply than any other facility (Gaither 1997:90). The Secretary of the Army approved the transfer of twenty German scientists led by Dr. Wernher Von Braun to Redstone Arsenal from Fort Bliss, Texas on October 28, 1949. They arrived on April 15, 1950 marking Redstone Arsenal's move into the missile era. Redstone Arsenal's responsibility was basic research and development and testing of free rockets, solid propellants, jatos, and related items. They were also responsible for the research and development of guided missiles (Redstone Arsenal website; [www.redstone.army.mil](http://www.redstone.army.mil)).

The U.S. Army made its most valuable contributions to space research from January 1950 to August 1962. During this period, the Army placed four earth satellites into orbit; launched the free world's first lunar probe and first solar satellite; launched three primates into space; initiated the effort on a 1.5-million-pound-thrust booster being designed for a lunar exploration vehicle; and began work on the launch vehicle to carry the first men into space. When NASA was created in July 1958, the Army's role in space research gradually diminished. On July 1, 1960, the 1,840-acre George C. Marshall Space Flight Center was created in the center of the Redstone Arsenal and the AOMC (Army Ordnance Missile Command) lost 4,000 employees and \$100 million in buildings and equipment at the Arsenal and Cape Canaveral. MSFC is the only NASA center located within an Army post. Today the remainder of the Redstone Arsenal serves as the U.S. Army's Aviation and Missile Command and various other Army organizations (Redstone Arsenal website; [www.redstone.army.mil](http://www.redstone.army.mil)) (Figure 2).



Figure 2  
Current Map of Redstone Arsenal



## V. WORLD WAR II MILITARY ARCHITECTURE

Propaganda posters from WWII declared, “Industrial lines ARE battle lines!” At Huntsville Arsenal, Redstone Arsenal, and the CWS storage facility, the industrial battle lines seemingly were created overnight using standard and adapted architectural plans, machinery, and materials. Efficiency, safety, utility, and speed in design and construction were the hallmarks of the industrial structures erected during WWII.

Contemporary American industrial architecture and international trends in design all influenced the construction of military industrial buildings. Steel and reinforced concrete were used as primary building materials as they were cost effective, resistant to sway, and capable of supporting heavy loads. This new building technology allowed for the construction of vast uninterrupted spans and replaced massive load-bearing masonry walls that had been the mainstay of industrial architecture since the nineteenth century (Cannan et al. 1996).

During the 1930s, the Army created a set of standardized plans, called the 700 Series, for a number of common structures that would be required in the event of war. Based in part on the inadequate 600 series of WWI, the new plans for structures such as barracks, chapels, warehouses, and movie theaters incorporated more modern requirements, such as indoor toilets, heating, and an allowance for the sheer numbers of soldiers using the facilities. Industrial buildings were not as readily addressed as manufacturing needs had typically been met by private contractors in the past. When it became clear that contractors alone could not produce the materiel necessary for running a global prolonged war, the Army began to consider the construction of industrial government-owned facilities to be operated by the private sector. This was considered a fortuitous marriage since the military faced problems in retaining specialized scientists and engineers.

During the Protective Mobilization period, private industry and the military came together to design prototypical industrial structures for very specialized materiel production. In 1939, Picatinny Arsenal and Edgewood Arsenal became testing grounds for new industrial buildings and processes related to chemical and ordnance production. Their experiences combined with the building plans from the private sector served as the basis of military industrial building design.

At the time, it was also believed that industrial facilities would be of permanent construction, much like private sector factories. (Permanent in this case refers to buildings that have a twenty-five-year life span.) Functionality was the top priority for industrial facilities, thereby determining the basic architectural and engineering design. Levin Campbell, Chief of Ordnance from 1941 to 1942, declared that “the object of building plants [was] to produce munitions required to win the war” (Kirv 1992). These industrial buildings were exceptionally plain, utilizing the pioneering work of Albert Kahn, the great industrial facilities architect, as a springboard for the understanding of how buildings best shelter industrial processes.

Always concerned with the cost of building materials, the military chose to use a number of lesser priced building materials, such as construction tile, for the permanent



structures. This was also due to the fact that a national shortage of lumber and timber mill workers left few wood products available for the defense effort. Construction tiles were essentially hollow bricks, approximately 8 inches wide, with a tensile strength that allowed them to be used in self-supporting walls and were virtually maintenance free. Larger industrial buildings were constructed with steel frames using other types of traditional building materials (Fine and Remington 1972:547).

With the U.S. entry into WWII, however, enormous cost overruns and the shortage of strategic materials resulted in a move toward temporary building construction. (Temporary buildings were to have a five-year life span.) At first, only amenities were cut and changed, but eventually whole industrial complexes were built of wood and asbestos paneling with little or no steel frames. This switch from permanent to temporary had a great affect on the three posts at Redstone Arsenal. While Huntsville Arsenal had a large multi-story permanent headquarters building (111), Redstone Arsenal had to make do with a single-story wooden structure (now demolished).

Each military division had different building regulations that also determined the types of structures built. The Ordnance Department, which built Redstone Arsenal, and the Chemical Warfare Service, which built Huntsville Arsenal and Gulf Chemical Warfare Depot, actually had varying building regulations that resulted in different construction design and materials.

Huntsville Arsenal's architecture is characterized by the permanent construction typical of WWII industrial mobilization. Administration, personnel support, and residential buildings employed a mixture of temporary and permanent construction. Chemical production buildings and storage facilities were adapted from Edgewood Arsenal's expansion facilities. All structures were built with durability, economy, materials conservation, and speed of construction in mind. A wide variety of construction materials were used including clay tile, wooden frame, metal frame, wood and transite™ siding, asbestos siding, and APM (asphalt protected metal) (Cannan et al. 1996).

Buildings within a production line at Huntsville Arsenal utilized a similar mix of construction techniques. Steel frame clad in metal is the most common. The exterior walls incorporated large, metal sash windows, and the interiors contained movable wooden apparatus and tables for the actual production work. Safety features, such as separation of chemical mixing areas with concrete walls, were employed to minimize the damage and casualties caused by accidents (Cannan et al. 1996). Air conditioning in line buildings was used only when absolutely necessary for the stabilization of chemical processes. Typically, workers wore respirators to minimize their exposure to chemical-laden air.

In 1942 when the Gulf Chemical Warfare Depot was created, the Army actually made use of two existing buildings for office and quarters space. Some items, including inert and toxic materials, were stored outside with minimal to no protection. This post was a bare bones facility utilizing every space to its maximum. Warehouses became dorms for the large worker population when housing could not be found off the post.

Like chemical service plants, ordnance plants were designed with maximum functional efficiency in mind. Architectural embellishments were kept to a minimum in an effort to save time, money, and resources. More than any other factor, economy became the directive for ordnance plants. General Brehon Somervell, Chief of Ordnance, was outraged at the branch's seeming preference for grandeur in buildings and declared that "there was no excuse for masonry structures, monumental or otherwise, where light frame structure will serve the purpose" (Cannan et al. 1996). In January 1941, Somervell announced that future ammunition plants would be designed as temporary installations.

Redstone Arsenal was built using a combination of permanent and temporary construction. A wide variety of construction materials were used including clay tile, wooden frame, metal frame, wood and transite™ siding, asbestos siding, and APM. Many of the plant's buildings were constructed so sparingly that portions of production lines were left exposed to the elements. Workers' clothing proved inadequate in the winter months, and many employees became sick or simply called in sick on cold days. To combat this problem, Cel-o-Glass, an inexpensive wire-meshed plastic, was used to enclose the open work areas. Absenteeism fell and production increased dramatically following this addition.

Both ordnance and chemical plants required vast amounts of water and power. Since these were not available from Huntsville or Madison County, the posts built their own powerhouses and water and sewage treatment plants. All of the installations were connected by an enormous system of railroads and roads and serviced by a dock facility on the Tennessee River. These networks were necessary to ship and receive material from outside the installations and to transport materials within and between the posts (Cannan et al. 1996).

The issue of how to fund the construction of these structures led to much debate and discussion among military officials. It was eventually decided that the War Department would issue cost-plus-fixed-fee contracts to the builders of its new industrial facilities. On July 16, 1941, the War Department signed such a contract with Baltimore architects/engineers Whitman, Requardt and Smith (WRS) for architectural and engineering services for the Huntsville Arsenal, Gulf Chemical Warfare Depot, and Redstone Ordnance Plant. It is notable that the three posts were built by the same architect/engineers since the Ordnance Corps and the Chemical Warfare Services generally sought different qualifications from their respective architectural and engineering firms. WRS had been in business since 1915 and more than met the exacting qualifications required for the creation of industrial facilities.

Immediately after WRS was contracted, a cost-plus-fixed-fee contract was awarded to C. G. Kershaw Contracting Company of Birmingham, Alabama; Engineers Limited of San Francisco, California; and the Walter Butler Company of St. Paul, Minnesota; for construction of the three posts. Major subcontractors included Chambers Lumber, Edge Moor Iron Works, Junemena Electric Company, O'Pry-Bryant Heating and Plumbing, Standard Asbestos Company, Midwest Construction Company (contractors for concrete igloos), Birmingham Slag Company (all concrete), Ralph Rogers (operation of quarry and furnishing of all stone used in construction), Lock Joint Pipe Company, Raymond Concrete Pile Company, Eller Olsen Asphalt Company

(paving, of all roads), Carrier Corporation (air conditioning in process buildings), Westinghouse Electric Company, and Graver Tank and Manufacturing Company.

WRS's contract called for the preparation of necessary reports, designs, drawings (many of which still exist and are housed at Redstone Arsenal), specifications, and the technical supervision for the construction of the posts. The firm designed buildings, railroad systems, road nets, water and sewage systems, gas lines, runways, and test and burn areas. WRS also had been contracted to modernize and expand existing old line ordnance plants, Edgewood Arsenal and Aberdeen Proving Ground. Whitman and Requardt (sans Smith) still operate today as architects and engineers in Baltimore, Maryland (*History of the Huntsville Arsenal* n.d.).



## VI. HUNTSVILLE ARSENAL

### BRIEF OVERVIEW

Construction of the Huntsville Arsenal began in August 1941 and plant lines started production in February 1942. The Arsenal's primary purpose during World War II was the manufacture of toxic gases, incendiary agents, and smoke munitions. Plants 1 and 2 were identical in function and manufactured toxic gas weapons. Plant 3 served as the smoke munitions and incendiary filling area. Other areas included the administrative complex, a small housing area, and the airfield, which was used for testing incendiary and smoke munitions. Today a large portion of the Plant Area 1 buildings are a part of the Marshall Space Flight Center and are, therefore, not included in this report (Figure 3). To fully understand the WWII mission of the Huntsville Arsenal and place it in its historical context, a discussion of toxic gases, smoke munitions, and incendiary weapons follows.

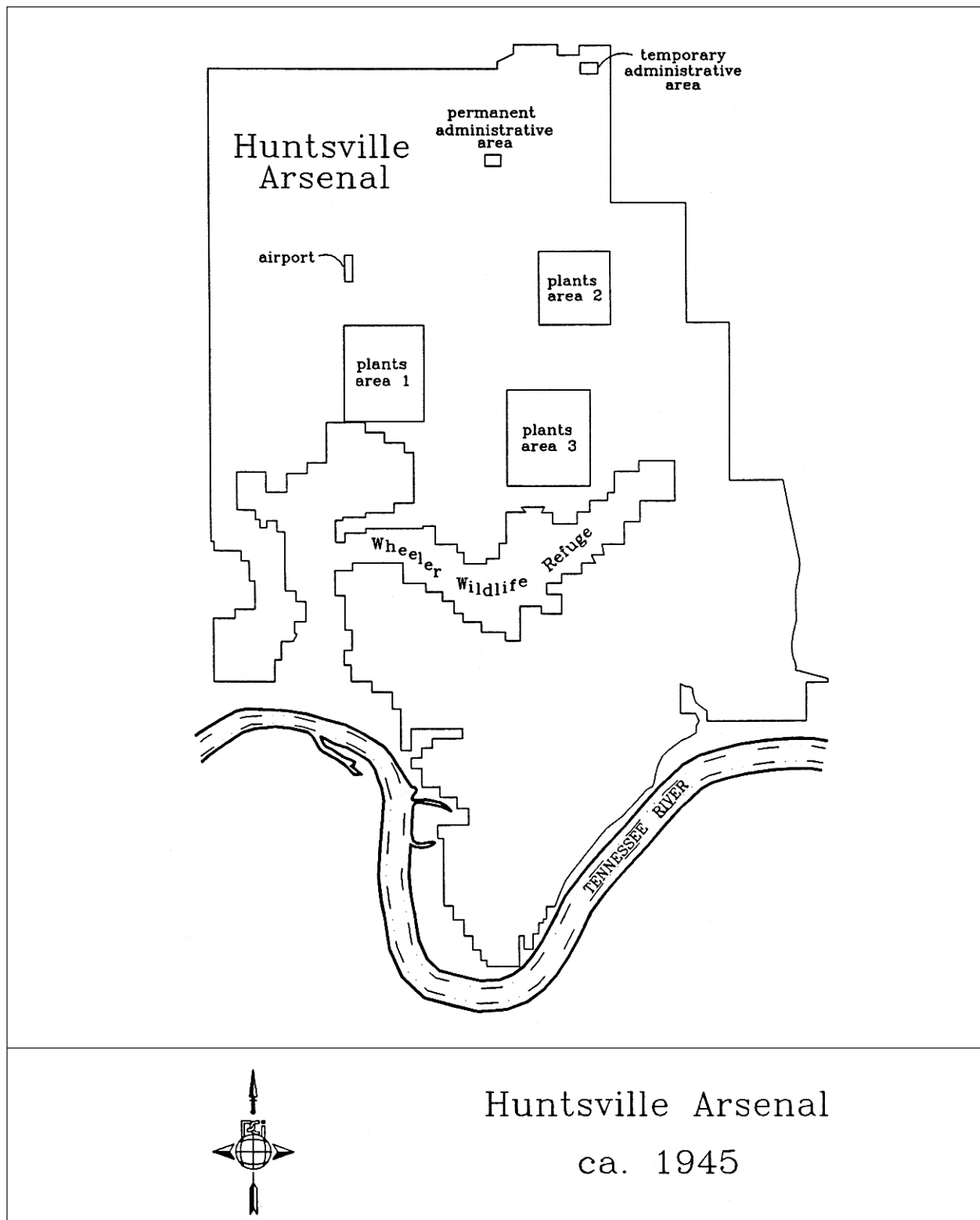
### TOXIC GAS PRODUCTION

The Germans were the first to use chemical weapons in World War I when they attacked French troops with toxic chlorine gas on April 22, 1915 near Ypres, Belgium. During the war 124,000 tons of choking and vesicant gases were used extensively by both sides with chlorine, phosgene, and later, mustard gas, being the primary toxic agents. This was, however, minor compared to the 2 million tons of high explosives and 50 billion rounds of small arms ammunition which were fired during the war (Spiers 1986:3). Toxic gas accounted for only 4.5 percent of the total artillery ammunition expended (Spiers 1986:26).

Despite their limited use, the public reacted to the use of chemical warfare with revulsion and fear, but the United States had no choice but to initiate a chemical weapons program of their own. At first the duties of developing and manufacturing toxic gases and protective clothing were distributed among several different departments, but by 1918 it was clear that one organization should be responsible for the creation, testing, and manufacturing of chemical weapons. As a result the Chemical Warfare Service (CWS) was created in that year as a division of the U.S. Army (Brophy and Fisher 1959:12). The duty of maintaining smoke and incendiary munitions was also delegated to the CWS in 1920 (Brophy and Fisher 1959:17).

At the end of World War I, the future of chemical warfare remained uncertain. Some military leaders doubted the effectiveness of toxic gases as a weapon since the chemicals often drifted back over the perpetrating army. Others predicted

Figure 3  
Layout of Huntsville Arsenal, c. 1945



Courtesy of Panamerican Consultants, Inc., 1998

that any future war would begin with an overpowering attack of chemical weapons on civilian population centers rather than military targets. To prevent such an apocalypse, the Geneva Protocol of 1925 banned the use of chemical weapons, although two of the major World War II players, Japan and the United States, had not signed the treaty by 1941 (Spiers 1986:62).

Despite the ban, experiments and chemical weapon production continued and the threat of chemical warfare still remained a very real concern throughout World War II. Neither side, however, was prepared or willing to initiate such a battle. The Allied policy was one of retaliation and deterrence. In 1942 and again in 1943, Roosevelt and Churchill vowed not to use chemical weapons unless they were attacked first. Hitler was also repulsed by the use of toxic gases and threatened to use them only in defense (Spiers 1986:78). The Japanese reportedly used poison gas against China in 1937 and 1938, but they heeded Roosevelt's vow and also refrained from an attack on the Allies (Spiers 1986: 86). Logistics in gas warfare contributed to its absence on the battlefield in World War II. Munitions had to be manufactured, loaded, shipped and stored very carefully to prevent leaks and accidents. There was also the concern of civilian morale and the means by which troops would have to protect them. Finally, the Allies and the Axis simply did not want to set the precedent for such warfare (Spiers 1986:87). These reasons kept chemical weapons from the World War II battlefield.

The Allies considered the use of toxic agents, however, on a few occasions. The American forces, for example, proposed chemical warfare in the Pacific Theater late in the war. Mustard gas would have been particularly well suited because high humidity made it four times more potent and the jungle canopy made it easier to administer lethal concentrations. A small number of officials, including the Chief of the CWS, Major General William N. Porter, believed mustard gas would have ultimately saved the lives of many U.S. soldiers. He thought that this would have held true in battles like Betio Island in November 1943, when even after 3,000 tons of high explosives were dropped on the Japanese, 4,690 Japanese and 3,000 American were killed in action (Freeman 1991:31-32). Despite the pressures from a few individuals, American military leaders paid little attention to gas in World War II (Kleber and Birdsell 1969:654).

In reality, the use of chemical weapons even in a retaliatory attack or for an offensive assault would have been impossible. There was, in fact, only a fourteen-day supply of toxic gas in Europe in the fall of 1943. This would have made a good first strike, but resupply would have been necessary by air. In the Pacific, the supply was down to only five days (Kleber and Birdsell 1969:651-52). Stockpiles, particularly in the Pacific, were difficult to maintain and had to be replenished regularly because the impurities of the gases, particularly mustard gas, corroded the metal casings, causing leaks (Freeman 1991:37).

Despite their resistance to resorting to chemical warfare and their seemingly low supply of chemical weapons, the Allies still had to make preparations. During World War II, each of the four CWS arsenals manufactured toxic agents, smoke and incendiary materiel. With these chemicals, workers filled shells, grenades, pots, and bombs which were, as a rule, supplied by the Army's Ordnance Department (Brophy and Fisher 1959:120). The chemical weapons produced during World War II by these arsenals were phosgene (CWS symbol, CG), mustard gas (H), hydrogen cyanide (AC), cyanogen

chloride (CK), Lewisite (L), nitrogen mustards (HN), chloroacetophenone (CN), and Adamsite (DM). Of these toxic agents, mustard gas was the most important in terms of the amount stockpiled. Phosgene would have also played a vital role in chemical warfare if it had occurred (Brophy et al. 1988:49-74). At the Huntsville Arsenal, the toxic gases produced included mustard gas, Lewisite, phosgene, chloroacetophenone (better known as tear gas) and Adamsite. Each of these gases will be described in more detail below when their respective production lines are discussed.

## SMOKE MUNITIONS

Smoke grenades and shells were employed on a limited basis in World War I to screen troops from enemy fire. The increasing development of air warfare between the two world wars resulted in the need for even larger ground troop concealment. Because of this need, the CWS perfected the employment of large area smoke screening (Kleber and Birdsell 1969:324). Never before had armies been able to protect their troops and hide their movements as successfully as Allied forces did in World War II (Brophy et al. 1988:197). The U.S. first used smoke shells, pots, grenades, and airplane tanks, but they could not maintain screens over wide areas (Kleber and Birdsell 1969:324). To remedy this, the CWS developed the M1 stationary oil generator which, when used in large numbers, could blanket four square miles. An improved version of the M1 was developed in September 1942. Often the M1 smoke pots and the generators were used in tandem with the smoke pots forming an inner ring for quick concealment of vital targets. The generators took longer to warm up, but later formed an outer ring of widespread smoke. The smoke pots also filled in gaps in the smoke blanket that may have been caused by shifting winds or other unforeseen circumstances (Kleber and Birdsell 1969:327). During the war the CWS procured over 5 million M1 smoke pots and over 880,000 M5 smoke pots (Brophy et al. 1988:373).

This new method of large area smoke screen was first used to hide Allied troops landing in North Africa in November 1942. In Europe, this tactic proved to be the most successful at river crossings and screening main supply lines (Kleber and Birdsell 1969:338). Smoke screening was not employed as much in the Pacific where it was more limited by geography. The Navy did, however, use it for anchorage screens to conceal vulnerable vessels. In the Pacific it was also used in half of the six airborne operations against Japan where it shielded paratroopers (Kleber and Birdsell 1969:394).

Floating smoke pots were developed in 1942 to screen amphibious forces. The M4 floating smoke pot was developed first, but it was modified in July 1943 to become the M4A1 smoke pot. A final model, the M4A2, was ready in March 1944 with a lower fuse that allowed the pots to be stacked on top of one another. Floating smoke pots were the most successful in the Mediterranean, on inland rivers, and on land when standard smoke pot inventories were low (Brophy et al. 1988:99-207).

There were two kinds of smoke used during World War II—white phosphorus and HC. White phosphorus (WP) is a soft waxy substance that reacts spontaneously with oxygen, throwing off a dense white smoke of phosphorus pentoxide. It was

unsurpassed as a smoke producer and the falling fragments of burning phosphorus also served as a valuable weapon against enemy troops. The CWS purchased 200 million pounds of WP from 1942 to 1945, far more than any other smoke agent. To obtain WP, one only needed phosphate rock deposits and a source of cheap electricity. Most WP used at the Huntsville Arsenal came from the Tennessee Valley Authority (TVA). WP was used as filling in shells, rockets, bombs, and hand and rifle grenades (Brophy et al. 1988:198,374). There was only one filling plant at the Huntsville Arsenal on the west side of Plant Area 1, now part of the Marshall Space Center. It began operations in May 1942 and continued through the end of the war. There were ten different WP munitions produced at the Huntsville Arsenal including the 4.2 mm shells, 75 mm shells, 81 mm M57's, and 105 mm M60 (*History of the Huntsville Arsenal* n.d.:483).

Along with WP was another smoke agent known as HC (a combination of hexachloroethane and other chemicals) which was most commonly used in smoke pots and to a lesser degree in other ammunitions such as grenades, shells, rockets, and bombs. HC was generally acquired from private industry (Brophy et al. 1988:372). At the Huntsville Arsenal, the chemical was mixed and loaded into ammunition shells including AN-M8 hand grenades, M1 105 mm canisters, smoke pots, M88 and M89 smoke shells, M20 rifle grenades, E18 canisters and M77 bombs. The production of these munitions took place in a variety of buildings in the smoke and incendiary filling area (*History of the Huntsville Arsenal* n.d.:506-590).

Almost all of the 2 million floating smoke pots procured by the CWS during the war were filled at Huntsville (Brophy et al. 1988:377). These included the M4 floating smoke pot that was produced from November 1942 through August 1943. From January 1944 to November and again in May-August 1945, the M4A2, the replacement for the M4, was also manufactured. The M1 smoke pot was created from March 1943 through the following month and then again from August 1943 through January 1944. These were also manufactured at Pine Bluff Arsenal and under contract with the New York and Dallas procurement districts. (Joiner 1966:32, Brophy et al. 1988:373).

## COLORED SMOKE MUNITIONS

Only Edgewood and Huntsville loaded colored smoke munitions during World War II and Huntsville, by far, completed most of this work (Brophy et al. 1988:377). Colored smoke was used in every kind of signaling by troops in the field. Planes relied on the smoke to recognize their own troops when bombing. Troops also used colored smoke to mark artillery targets for fire, to communicate with tanks, and signal other troops. It was a valuable tool and over 5 million colored smoke munitions were produced between 1942 to 1945. Although colored smoke was a significant development, historians believe it was of little importance when compared to the CWS's 4.2-inch chemical mortar, mechanical smoke generators, incendiary bombs, toxic agents, and gas masks (Brophy et al. 1988:224).

At the Huntsville Arsenal, the manufacture of colored smoke grenades began in October 1942 (Redstone Arsenal website, [www.redstone.army.mil](http://www.redstone.army.mil)). Colored smoke

munitions were created in a variety of buildings in the smoke and incendiary munition area of the Huntsville Arsenal. Munitions produced included the M16, M18, and AN-M3 grenades, M2 105-mm canister, M3 and M4 105-mm canister, and the M22 and M23 rifle grenades (*History of the Huntsville Arsenal* n.d.:664-736). All dyes came from private industry (Brophy et al. 1988:220-223). Grenades were the most commonly used colored smoke munitions, although pilots also used smoke bombs. The M7 grenade was the first munitions to be filled with colored smoke, but the M16 grenade became the standardized grenade in April 1943 with six colors—red, orange, yellow, green, violet, and black (Brophy et al. 1988:220-223). It was first produced in Huntsville in October 1942 (Baker and Hughes 1993:16). The M-18 replaced the M16 and was manufactured at Huntsville beginning in November 1943 (Joiner 1966:37). This grenade created a larger volume of smoke than its predecessor did and only four standard colors were issued—red, yellow, green, and violet. In 1943 rifle grenades were developed to throw the colored smoke farther. The M-22 rifle grenade could also be used in a grenade launcher or a carbine and was first created in Huntsville in March 1944. Production ran through April 1945 when problems with the yellow grenades halted the lines until July (Joiner 1966:38). The M-23 colored smoke rifle grenade was developed for use in the jungle or forested areas as it released a stream of smoke high in the air. Filling plants made more than a half million of the impact and streamer grenades in 1944 and 1945 (Brophy et al. 1988:220-223). Also created at Huntsville were M2 colored smoke canisters, which were used by artillery to signal and identify. These were produced in red, violet, green, orange, and yellow from May 1943 to July 1945. The M3 and M4 canisters were also made at Huntsville from February 1944 to April 1945. They were designed to be used in base ejection of the 155 mm ordnance shell and came in four colors—red, yellow, violet, and green (Joiner 1966:38). The Huntsville Arsenal also manufactured E-18 colored smoke canisters which were designed for the Air Corps and functioned as aerial smoke bombs used to mark bombing missions (Baker and Hughes 1993:42).

The dye used in the various smokes colored the production workers' clothing and skin, creating a startling rainbow of hues that could be seen regularly on the streets in Huntsville. The rainbow-colored skin that could not be washed clean was not without its particular compensation; workers in colored smoke areas, both men and women, were paid at a high salary rate (Joiner 1966).

## INCENDIARY WEAPONS

Another responsibility of the CWS and the Huntsville installation was the production of incendiary weapons. Development of incendiaries began during World War I, but they proved to be ineffective in battle. Military leaders believed high explosives were much more destructive (Brophy et al. 1988:167). By August 1944, however, the Army Air Forces Board determined that where there was a vulnerability to fire, the damage was actually more devastating than demolition. This was certainly clear in the London blitz of 1940, but the U.S. did not act upon this realization until later in the war at which point they stepped up the incendiary program (Green et al. 1955:468). Fire proved to be particularly successful on urban targets in Japan where a

large number of buildings were constructed of paper and wood. It was less effective in Germany where most structures were built of brick and stone. However, U.S. bomber planes could not reach Japanese cities until the Mariana Islands were taken in July 1944. The March 1945 attack on Tokyo, for example, created an inferno that left 83,793 dead and 1 million without homes. It destroyed 15.8 square miles (Kleber and Birdsell 1969:628). These blitzes continued on sixty-nine Japanese cities which some believe gradually won the war in the Pacific. Nearly a quarter of a million incendiary and fire bombs were used on German and Japanese targets, but they really did not come into their own until the last six months of the war (Kleber and Birdsell 1969:647).

Most historians conclude that incendiary devices were certainly the CWS's greatest accomplishment, considering their contribution in bringing the war to a successful conclusion. The CWS procured more incendiary bombs than any other single component and it spent more money and employed more manpower on incendiaries than on any other item of supply (Brophy et al. 1988:196). They are also remarkable because most of them were investigated, designed, and developed after the United States had entered World War II (Kleber and Birdsell 1969:614).

There were two primary types of incendiary weapons used during World War II—incendiary bombs and firebombs (Incendiary grenades were also employed, but to a lesser extent.). Of the two types, the incendiary bomb was by far the most important (Kleber and Birdsell 1969:614). Incendiary bombs were generally used behind enemy lines and fire bombs were dropped at lower altitudes closer to the front and were most effective against enemy strongholds and troop concentrations, inflammable materials, and motorized vehicles (Brophy et al. 1988:614; Kleber and Birdsell 1969:635). Firebombs were essentially a large capacity container filled with napalm gel, which was released over targets. The Air Force dropped about 37,000 CWS firebombs or 14,000 tons on German and Japanese targets, but two-thirds of these were used in the Pacific (Kleber and Birdsell 1969:635).

The first incendiary product manufactured at the Huntsville Arsenal was the four-pound M-54 incendiary bomb, which was filled with a thermite mixture. Production began in March 1942, but lasted for only a month when a fire destroyed the facility. The M-54 was not produced again at Huntsville because the Army no longer required them (Joiner 1966). The bomb was used very little during World War II as it was designed as a substitute for the M-50, one of the most commonly used incendiary bombs. The M-54 was constructed with a steel case while the M-50 required magnesium. The latter was difficult to obtain and until it was, steel was the replacement. The M-54 was, however, used in the first air strikes against the Japanese homeland in 1942, but it was declared obsolete in 1945 with 13 million still in warehouses (Kleber and Birdsell 1969:623).

Other types of incendiary bombs manufactured at Huntsville include the 100-pound gasoline-filled M47A2 (a derivative of the popular M47), the six-pound M69 oil bomb, and the 500-pound M76 (Joiner 1966:36). Nearly all of these bombs were created in building 5681 in Plant Area 2 which still stands today, but in extremely altered condition (*History of the Huntsville Arsenal* n.d.:609).

M47A2s were first made at Huntsville in March 1943. Over 280,000 were produced through the end of the year (*History of the Huntsville Arsenal* n.d.:610). First available in 1943, the M69's success depended largely on the M-1 fuse which allowed a single blob of the incendiary filling to be ejected several yards from the landing site rather than burning where it landed or scattering. Production of this fuse and the M69 began in Huntsville in May 1943 and continued to July 1945 (Redstone Arsenal website [www.redstone.army.mil](http://www.redstone.army.mil), Brophy et al. 1988:184-6). Workers at the Huntsville Arsenal also manufactured the tail streamers for these bombs when supply from private vendors became insufficient in November 1944. Production of the streamers continued until February 1945 (*History of the Huntsville Arsenal* n.d.:653). These bombs were also manufactured at several other CWS arsenals around the country (Brophy et al. 1988:348). When the great air campaign over Japan began in November 1944, officers decided to step up the use of incendiaries and dropped 400 tons of M-69s over Tokyo. On the famous March 9, 1945 attack on Tokyo, 2,000 tons of incendiaries were dropped and most were clusters of M-69s (Brophy et al. 1988:184-6).

America's largest incendiary bomb, the M76 weighed 500 pounds and was often referred to as the Block Burner. It contained an incendiary gel (PT-1) which would scatter into large globs in a 100-foot radius (Kleber and Birdsell 1969:618). More accurate and with greater penetrating power than the smaller bombs, the M76 was dropped primarily on well-constructed industrial and military targets that could withstand the smaller bombs. The M76 was the heaviest incendiary bomb standardized by the CWS during World War II and was used for the first time against Berlin in March 1944 with moderate success. Although it was not used as often as the smaller bombs, almost 40,000 were dropped over both Japan and Germany. Because of its size, however, there were few targets it could be used for and by September 1944, the M76 was no longer used and most were returned to Air Force depots. Over 60,000 M76's were created at the Huntsville Arsenal from December 1943 to May 1944. Aside from the Huntsville Arsenal, the M76s were also manufactured at the Edgewood Arsenal (Kleber and Birdsell 1969:618, Brophy et al. 1988:181).

Other devices produced in Huntsville were the AN-M14 grenades that were modified thermite incendiaries capable of melting 3/8-inch steel. Second in production only to incendiary bombs, the M14 was the standard CWS grenade. Between 1942 and 1944, the CWS procured 8 million (Brophy et al. 1988:191). Production in Huntsville began in August 1943 and continued through December of that year (Joiner 1966:37). The M14 was a powerful weapon which was used to trip Japanese wires at night, destroy disabled tanks, ignite gas in caves and enemy strongholds, and signal after dark. It was, however, one of the least employed grenades because it did not have the capabilities first envisioned such as the ability to burn through tanks, ruin cannon rifling or weaken bridge girders. By 1943 there were so many on hand and the troops were using them so slowly that the CWS stopped production and made no more for the remainder of the war (Brophy et al. 1988:191). The primary production of this weapon at the Huntsville Arsenal occurred in building 3532, which has since been destroyed (*History of the Huntsville Arsenal* n.d.:639).



## HUNTSVILLE ARSENAL HISTORICAL BACKGROUND

During the Protective Mobilization in the summer of 1940, the War Department took a close look at all of its facilities, especially those involved in production of materiel of various types. The United States had only one chemical manufacturing installation, Edgewood Arsenal, located at the northern end of the Chesapeake Bay in Maryland, which was the home of the CWS. Edgewood was not large enough even when expanded in 1941 to handle the increased production schedules. As a result, three new CWS manufacturing facilities were planned. The first was Huntsville Arsenal, followed by Pine Bluff in Arkansas, and Rocky Mountain in Colorado. All of these were responsible for producing a wide range of toxic chemicals, incendiaries, smoke munitions, and protective clothing (Spiers 1986:75).

CWS arsenals were maintained as government-owned, government-operated (GOGO) installations. Unlike most other military production facilities that were operated as government-owned, contract-operated (GOCO) installations, chemical facilities were considered too dangerous to be operated outside of government control (*History of the Huntsville Arsenal*, n.d.).

In July 1941, construction of Huntsville Arsenal was authorized, land was secured by condemnation proceedings, and the War Department signed a cost-plus-fixed-fee contract with WRS for architectural and engineering services for Huntsville Arsenal, Gulf Chemical Depot, and Redstone Ordnance Plant.

The original letter of authorization called for the following facilities at Huntsville Arsenal:

...eleven manufacturing plants, four chemical loading plants, a Chemical Warfare Depot, plant storage, laboratories, shops, offices, hospitals, fire and police protection installations, communications, and utilities to include roads and railroads necessary for the production, loading or filling into munitions, storage and shipping of offensive types of Chemical Warfare munitions (*History of the Huntsville Arsenal* n.d.).

By the termination of WRS's and Kershaw Butler's contracts in June 1943, they had constructed the following at the Huntsville Arsenal:

1,016	Buildings and structures
66	Miles of paved roads
25	Miles of gravel roads
60	Miles of railroad
136,000	Linear Feet (L.F.) fence
396,400	L.F. water mains and services
191,500	L.F. sewer mains and laterals
138,280	L.F. steam and return distribution
480,000	L.F. electrical distribution and services

At termination, approximately \$80,000 of purchase order items were undeliverable (*History of the Huntsville Arsenal* n.d.). The CWS assumed all remaining orders.

The CWS continued to construct a number of important buildings and sites after the private contracts expired. Their projects included a POW camp, several cafeterias, and additions to the officers' club, as well as the oil bomb filling plant and the phosgene plant. The CWS built inert warehouses, dry ice storage facilities, bomb target walls, and the airport hanger (*History of the Huntsville Arsenal* n.d.).

On August 4, 1941, Col. Rollo C. Ditto (1886-1947), the first Commanding Officer of Huntsville Arsenal, broke ground for the initial construction. Ditto was a WWI veteran who had been working under the CWS since 1921 at various posts including Edgewood Arsenal, the Office of the CWS Chief in Washington, D.C., and the Pittsburgh Chemical Warfare Procurement District. He became C.O. at Huntsville in August 1941 and retained this position until May 1943 when Col. Geoffrey Marshall took over. The Huntsville Arsenal began operation within only seven months after Ditto arrived and the facility earned four Army-Navy "E" Awards during the war. Ditto also became the C.O. of the Gulf Chemical Warfare Depot when it was established in September 1941 (Redstone Arsenal website, [www.redstone.army.mil](http://www.redstone.army.mil)).

Railroad tracks were first laid to deliver heavy equipment and supplies to other construction areas. While the plant areas were being built, temporary headquarters and other administration buildings were completed. The temporary administration center was located in the old "Splinter City," now the location of the Army Recruiting Center at the farthest northeastern point of Huntsville Arsenal.

The events of December 1941 quickened construction and on February 28, 1942, Huntsville Arsenal's first product came off a pilot line for M-54 incendiary bombs set up in Warehouse #642, a building that was later destroyed by fire. By March, Huntsville Arsenal's first production facility was fully activated (Baker and Hughes 1993).

Between 1941 and 1943, Huntsville Arsenal opened a number of different manufacturing plants and lines. Since many of the production buildings were extremely adaptable, Huntsville facilities could be altered to produce various types or calibers of munition with very little trouble. Even one of its mustard gas filling plants (Building 5681) was converted into an incendiary oil plant. As late as July 1943, Huntsville Arsenal was adding major components, including an iron carbonyl plant.

By 1944, Huntsville Arsenal reached both its peak dollar value of production and civilian personnel employment. Records from May of that year indicate that 6,707 civilians worked at Huntsville Arsenal. During March alone, this formidable force produced over \$5.7 million in materiel primarily in the form of the M-69 bomb, a very expensive item that helped drive up the production dollar figure (Redstone Arsenal website, [www.redstone.army.mil](http://www.redstone.army.mil)).

By 1943, Huntsville Arsenal had a need for an airfield to proof test its many munitions. The CWS used the Huntsville Arsenal airfield as the main proving ground

for incendiary munitions from numerous bases during WWII because of the area's good climate and visibility. Between 1943 and 1945, Army bombers dropped more than 8 million pounds of chemical munitions at Huntsville Arsenal, many on a simulated village known as "Little Tokyo" (Hughes 1992:3).

Other tasks undertaken at the Huntsville Arsenal included the operation of a clothing renovation plant beginning in April 1942. Its objective was to make and launder permeable clothing that would protect against vesicant vapors by impregnating the fabric with a compound that neutralized the vapors. The mix for impregnating clothing was made at various places in the Smoke Munitions Filling area, including Buildings 3478 and 3479 (*History of the Huntsville Arsenal* n.d.). Workers at the Huntsville Arsenal also reworked M200 fuses used in grenades that were not waterproof and failed in the field. Sporadically from June 1944 to July 1945, workers in Huntsville replaced the M200 fuses with M201s (Joiner 1966:40-41).

In January 1945, the Arsenal had its first contact with rocket research when it was ordered to test liquid propellants and methods of using them. Known as the FRED Project, this first brush with the missile era was terminated in September after the system's feasibility was demonstrated with the launching of two JB-2 flying bombs (similar to the German V-1 bomb). In May of that year the Germans surrendered at Rheims (Joiner 1966:40-41).

Huntsville Arsenal became the sole manufacturer of colored smoke munitions and was noted for its vast production of gel-type incendiaries. During WWII, more than 27 million items of chemical munitions with a total value of more than \$134.5 million were produced (Baker and Hughes 1993).

Huntsville Arsenal had been built as a permanent installation and at the end of WWII a decision as to its future mission had to be made. The Report of the Board of Permanent Construction at Installations Chosen for Postwar Retention, more commonly called the Spraker Board, recommended that Huntsville Arsenal's primary post-war mission be the production of smoke materiel and the emergency production of chemical agents. In September 1945, all plants were placed in "standby storage", and during the rest of that year, clean up procedures took place. Burn areas were designated and disposal of materiel began. The M-45 incendiary program paid for itself through the civilian purchase of empty wooden boxes used for shipping. The extreme shortage of lumber created a high demand for these boxes, many of which were used for flooring in post-war houses.

During 1946 and 1947, the post engineer began to lease acreage to farmers for cotton production and building space to chemical companies and other corporations such as the Keller Motor Corporation. Chemical companies began to make organic chemicals, insecticides, and other related materials.

On October 1, 1948, Huntsville Arsenal was placed under the command and control of the Commanding General, Third Army, for participation in the Territorial Command Test (Operation TACT). It was to have reverted to the Chemical Corps, but remained under the Command of the Third Army until June 30, 1949, when it became a part of Redstone Arsenal (Baker and Hughes 1993).

## HUNTSVILLE ARSENAL LAYOUT AND REMAINING WWII RESOURCES

Three general types of buildings were constructed at the Huntsville Arsenal: permanent, semi-permanent derived from the Army's 700 and 800 series plans for mobilization; and industrial permanent (Cannan et al 1996). Permanent buildings were favored early in WWII and were used in the creation of CWS arsenals. The permanent structures at Huntsville Arsenal were constructed of a variety of materials, including hollow clay tile, wood and metal frames, and wood, metal, and transite™ siding.

The AMC context shows that CWS installations can be divided into discrete areas based on function (Cannan et al. 1996). These areas include administration, chemical production lines and/or plants, depot, magazine areas, water and sewage treatment facilities, and an ordnance plant area. In the case of the Huntsville Arsenal, the adjacent Redstone Arsenal served as its ordnance area, and a separate depot, Gulf Chemical Warfare Depot, provided storage space, although the depot was under the command of Huntsville Arsenal. Unfortunately, the AMC context has far less information about CWS installations than it does about other posts now under the umbrella of AMC.

As shown on many historic maps and blueprints, Huntsville Arsenal was divided into distinct areas. The most prominent were the plant areas. At Plants 1 and 2, workers produced a wide range of chemicals while incendiary materiel was manufactured at Plant 3. Each of the three plant areas included a number of production lines and were sited on large tracts of land. The plants were situated well away from each other, and, in some cases, the lines within each plant were also separated for safety reasons. Each plant appears to have had its own steam plant, fire house, maintenance buildings, laboratories, warehouses, magazines, and offices; in essence, each plant was a small city operating with its own equipment and facilities. The individual lines were either housed in one, large building or in a number of separate structures grouped together. Various lines sometimes shared change houses or warehouses.

The administrative area was set apart from the remainder of the post on a hill that provided a commanding view of the surrounding rolling terrain. This area included housing for officers and personnel as well medical facilities. The administrative area also had its own boiler house, fire house, sewage stations, and maintenance buildings.

A third area was the airfield located in the secluded upper northwest portion of Huntsville Arsenal. This was an ideal location for proof bombing runs since it was virtually isolated from all other parts of the Huntsville Arsenal, as well as the City of Huntsville. The surrounding tracts of land were immediately available for bombing.

To further organize the structures on the post, the World War II era buildings remaining at the original Huntsville Arsenal installation were grouped into one of seven historic uses—administrative, housing, manufacturing, storage, infrastructure, and maintenance. On occasion, a building may have served several purposes during the World War II period and there are some whose original function remains unknown. Since Panamerican, Inc. undertook the World War II building survey in 1995-1996, twenty-eight of the approximately 168 documented structures have been demolished.

The thirteen administrative buildings remaining are office facilities, but several of them also housed lockers or cafeterias. The most significant of the office spaces are the large multi-story buildings (110, 111, 112, 113) located in the administrative center of the Arsenal described above. Other administration buildings are small offices in the former plant areas (3421, 3655, 4381, 4424, 5421, and 5565). Except for the office in the carbonyl iron unit (5565), all of these buildings have been drastically altered with new metal siding. The unaltered offices are relatively small buildings constructed of masonry tile with flat roofs and multiple entrances.

Former housing facilities represent only seven of the remaining historic World War II buildings at the Huntsville Arsenal. All are located in the former Huntsville Arsenal administrative center. Two are former barracks buildings (116 and 118) which have been severely altered and are now clad with metal siding and used for office space. The other houses (55, 56, 58, 60, and 62) are discussed in detail below.

There are eight historic maintenance buildings that were used as maintenance or repair shops (3197, 3623, 3664, 3790, and 5412) and gas or oil dispensing stations (3622, 3639, and 5690). These are spread throughout the Arsenal and have no distinct building pattern. They are in various states of alteration with buildings 3790, 3622, and 3639 having the most integrity. The maintenance shops tend to have been clad with new siding and were adapted for other uses. The gas and oil stations have remained the same and are used for their original purposes.

Infrastructure buildings include boiler houses (115, 3624, 4725), fire stations (114, 3627, 4424, 5414), a booster pump station (122), a telephone switch house (3236), an air compressor building (3629), substation (3796), a sewage treatment plant (4637), and a gasoline pump house (5689). Because these buildings served different purposes, they are all very different in form and are spread out around the plant areas. They are also in various states of alteration. All of the boiler houses are still used for their original purpose. Buildings 3624 and 4725 are of comparable size. They are massive, multi-story structures with flat roofs and constructed of clay tile and concrete respectively. Unlike many of the other industrial buildings on the post, neither of these resources has been dramatically altered, although they have been enlarged. Building 115 is of a much smaller scale and is only one story, but it is now sheathed with modern metal siding. The former fire stations at the Huntsville Arsenal have also been clad with replacement metal siding. Buildings 114 and 5414 appear to be similar in shape and scale with a two-story plan and flat roofs. Building 3627, however, is only one-story. Most of the remaining infrastructure buildings are small, flat roof buildings constructed of clay tile. They often have only one central door, although Building 3236 has two. Building 4637 is a larger version constructed of concrete with two central doors to house the sewage treatment works. All of the remaining buildings have faced little or no alterations. None of these buildings hold any special historical significance nor are they architecturally significant.

Storage buildings at the Huntsville Arsenal make up fifty-nine of the historic buildings remaining. During the war approximately twenty warehouses, ten magazines, and ten standard igloos at the GCWD were assigned to both the manufacturing and filling department (Plant Area 1 and 2) and the smoke and incendiary loading department (Plant Area 3). Whenever possible components

necessary for production needs were stored nearest to the operating line to facilitate the manufacturing process. The original design of the plant lines, however, included practically no facilities for the storage of necessary components near the lines. Deliveries, therefore, had to be closely coordinated to meet production schedules. The exception to this was in the mustard gas, white phosphorus, and M69-M74 incendiary bomb production areas where storage facilities were available nearby (*History of the Huntsville Arsenal* n.d.:802).

The remaining storage facilities at the Huntsville Arsenal can be divided into three primary groups: warehouses, magazines, and storage tanks. The warehouses are of the same general form—one-story, balloon frame structures with corrugated metal exterior or clay tile buildings. All have multiple sliding doors with gable roofs. A typical warehouse measures 250 x 60 feet, although a few are 33 feet wide. There are two major groupings of warehouses in the Arsenal. Buildings 3613, 3614, 3615, 3616, 3617, 3618, and 3619 are stretched out along Entac Circle in Plant Area 3. They are identical corrugated metal buildings (although some have replacement siding) which probably housed smoke munitions and incendiary supplies. Buildings 3631, 3632, 3633, 3634, 3635, and 3636 are grouped in rows off Patriot Drive. They are constructed of hollow clay tile and also measure 250 x 60 feet and probably stored smoke munitions. Other warehouses are spread throughout the Arsenal. Most remain in good to fair condition and are being used for a variety of uses including storage space, offices, and repair shops.

There are also approximately ten magazines remaining at the Huntsville Arsenal, which are nearly identical and measure 20 x 20 feet. They are constructed of clay tile and have flat roofs with a single central door. They are also located throughout the installation and tend to be spaced far from other buildings as they probably held explosive components. Examples of these include 3476, 3524, 3525, and 3789.

The ten storage tanks (5631, 5691, 5692, 5693, 5694, 5695, 5696, 5697, 5698, 5699) are located in the fenced tank farm in the southern end of Plant Area 2. There are two varieties—cylinders resting on concrete cradles on their sides or half-cylinders placed directly on the ground. The latter are six, eleven, or twelve meters in diameter.

The remainder and majority of the buildings in the plant areas at the Huntsville Arsenal were industrial facilities, which served a number of manufacturing functions during World War II. It is difficult to categorize these industrial structures into separate building types because they each served different purposes and some were constructed to house a variety of activities. Buildings on the lines utilized a variety of construction techniques. The exterior walls, made primarily of wood or tile, had large windows that allowed light and air. The large, open interiors could be easily adapted to meet new production quotas and requirements. Many featured safety characteristics, such as the separation of chemical mixing cubicles within concrete walls as well as “blow out” construction to ensure a blast would go up but not out. Buildings at all the CWS installations typically mimicked the pattern of construction developed at Edgewood by WRS. Steel frame buildings clad with metal made up most of the production line buildings (Nolte 1998:21). The mustard gas buildings (5661, 5662, 5663, 5666, 5671, 5672, and 5673) remain the most unaltered group of this building type. There are also a number of buildings, particularly in the incendiary and smoke munitions areas,

constructed of hollow clay tile. Buildings 3553 and 3560 were excellent examples of this building type which remain unaltered until they were demolished in 2000. Although used for different purposes in the smoke munitions filling process, both had shed roof porches and a variety of entrance doors leading into small cubicles. Most of the other buildings in this area have been severely altered with new siding and removal of original doorways. The carbonyl iron unit (5561, 5562, 5563, 5564, 5565, 5566, 5567, and 5572) also contains a large number of hollow clay tile buildings. These buildings are the most intact group of structures at the Arsenal.

### Administrative Area

Table 1. Huntsville Arsenal—Administrative Area

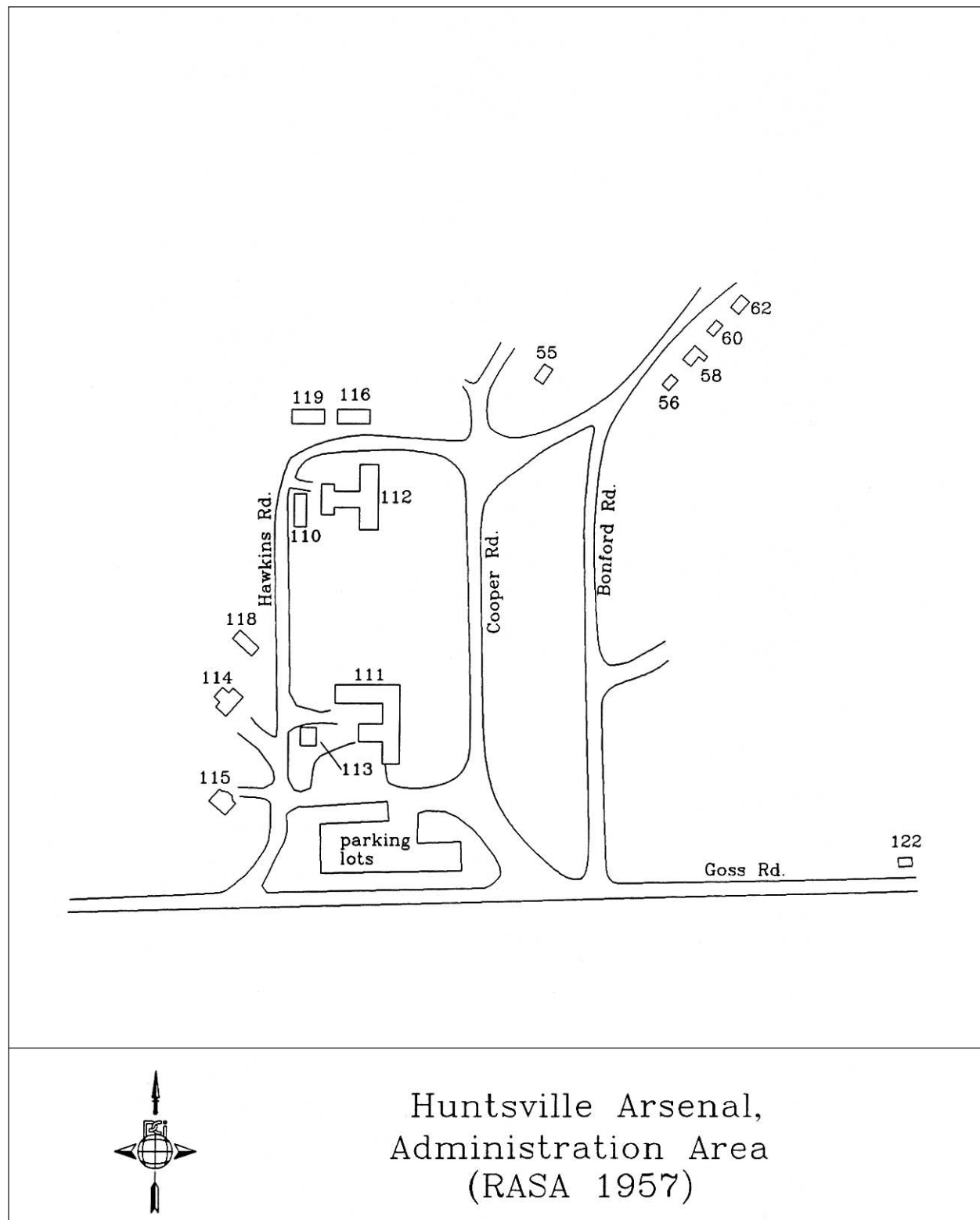
Building Number	WWII Use	NRHP Recommendation
55	Staff Quarters	Not Eligible
56	Staff Quarters	Not Eligible
58	Staff Quarters	Not Eligible
60	Staff Quarters	Not Eligible
62	Staff Quarters	Not Eligible
110	Hospital Annex	Not Eligible
111	Huntsville Arsenal Headquarters	Not Eligible
112	Hospital	Not Eligible
113	Communication Building	Not Eligible
114	Fire Station	Not Eligible
115	Boiler House	Not Eligible
116	Nurses' and Doctors' Quarters & Mess	Not Eligible
118	Medical Detachment Barracks & Mess	Not Eligible
122	Booster Pump Station	Not Eligible

When Col. Rollo C. Ditto arrived at the future site of the Huntsville Arsenal, he was greeted by rolling hills and empty fields. He and his staff immediately set up headquarters in the Huntsville National Guard Armory and the Huntsville High School gymnasium. From early August until mid-September 1941, Col. Ditto and crew operated from these makeshift offices. On September 14, 1941, they moved into another temporary headquarters in the old "Splinter City", now the site of the Army Recruiting Center, at the furthest northeast point of Huntsville Arsenal.

Permanent headquarters were constructed by 1942. The 1942 *General Area Map of Huntsville Arsenal* (WRS 1942) shows a rectangular-shaped area of six buildings nestled on the north slope of Ward Mountain accessed by Highway 3, now Goss Road. Later in 1942, a doctors' and nurses' mess was added on the west side of the rectangle, and five officers' quarters were added in a loop to the northeast of the administrative area. By December of that year, increased personnel made it necessary to build a \$160,000 addition to the headquarters building (111) (Nolte 1998:27-28) (Figure 4).

The entire administrative area must have been impressive as compared to the remainder of the post. Historic photographs of the administrative building shows it

Figure 4  
Layout of Huntsville Arsenal, Administrative Area



Courtesy of Panamerican Consultants, Inc., 1998



surrounded by trees and grass much like it is today. Unlike the raw bulldozed areas around the manufacturing plants and lines, an attempt was made to give this area a sense of permanence and superiority.

The administrative buildings were of permanent construction and built of red clay hollow tile. A copy of some of the buildings' blueprint still exists, providing an excellent snapshot of the area. The buildings' style can be best described as "stripped classicism." They do not at all resemble the manufacturing facilities over which they had dominion, instead they are more like the public buildings of the 1930s. This style, also called "WPA Modern," is intended to represent the power of the state by employing elements of classical architecture. This approach, recognizing its ancient antecedents, uses classical moldings, cornices, and conventional proportions but avoids the use of orders and is generally free from historical precedent. Its forms are clean, clear, and generally simple (Kane 1994).

True to stripped classical form, the two-story administrative headquarters (111) is set on a raised basement and constructed using classical proportions as shown in a ca. 1943 photograph (Figure 5). The main façade originally featured fifteen bays with a slightly projecting central panel with a set of double doors accessed by a staircase. The windows and doors are beautifully proportioned and originally were painted black (Figure 6).

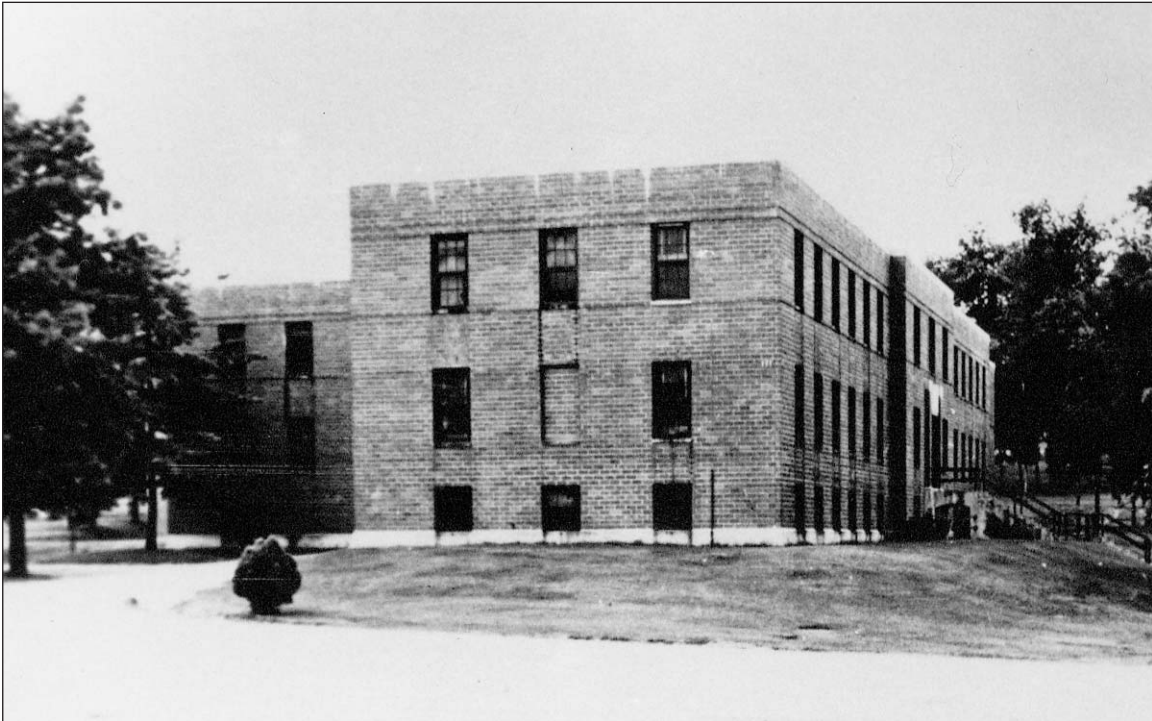
While the building is simple, it did possess ornamentation that suggested authority. Constructed of red clay tile with a slightly overhanging parapet, each floor was delineated by beltcourses. All the windows had cement sills and simple square pilasters flanked the double front doors. Surrounding the entire base of the building is a line of white concrete. The total effect was one of no nonsense authority. The building, however, has since been totally encased in vinyl siding and the windows shortened. Very little of the original detailing remains (Figure 5).

Although no original blueprint exists for Building 112, the largest structure in the area, it can be assumed by its current proportions that it also featured the same stylistic elements as the headquarters building. In fact, blueprints for even the smallest building in the area reflect the same characteristics. The nurses' and doctors' quarters and mess (116) was built in this style. This one-story structure is also built of red tiles and features belt courses around the upper level and windows with cement sills.

In April 1942, Col. Ditto was authorized to construct five staff quarters. The work was subcontracted to Chambers Lumber Company of Athens, Alabama, and cost \$37,000 (*History of the Huntsville Arsenal* n.d.). The staff quarters were conveniently located within walking distance of the administrative area in a small loop off the northeast corner.

All of the original officers' housing in the administrative area is intact. A blueprint labeled, "Standard Staff Quarters" (7121) (Figure 7) shows the plans for buildings 7121 through 7125 on the Redstone Arsenal which included houses ranging in size from 616.04 square feet to 621.84 square feet. Extended notes on the blueprint

Figure 5  
Building 111 Photographs



A. Historic photograph of administration building, Building 111 (AMCOM History Office).



B. 1996 photograph of Building 111, south elevation from Cooper Drive (Panamerican Consultants, Inc., 1998).

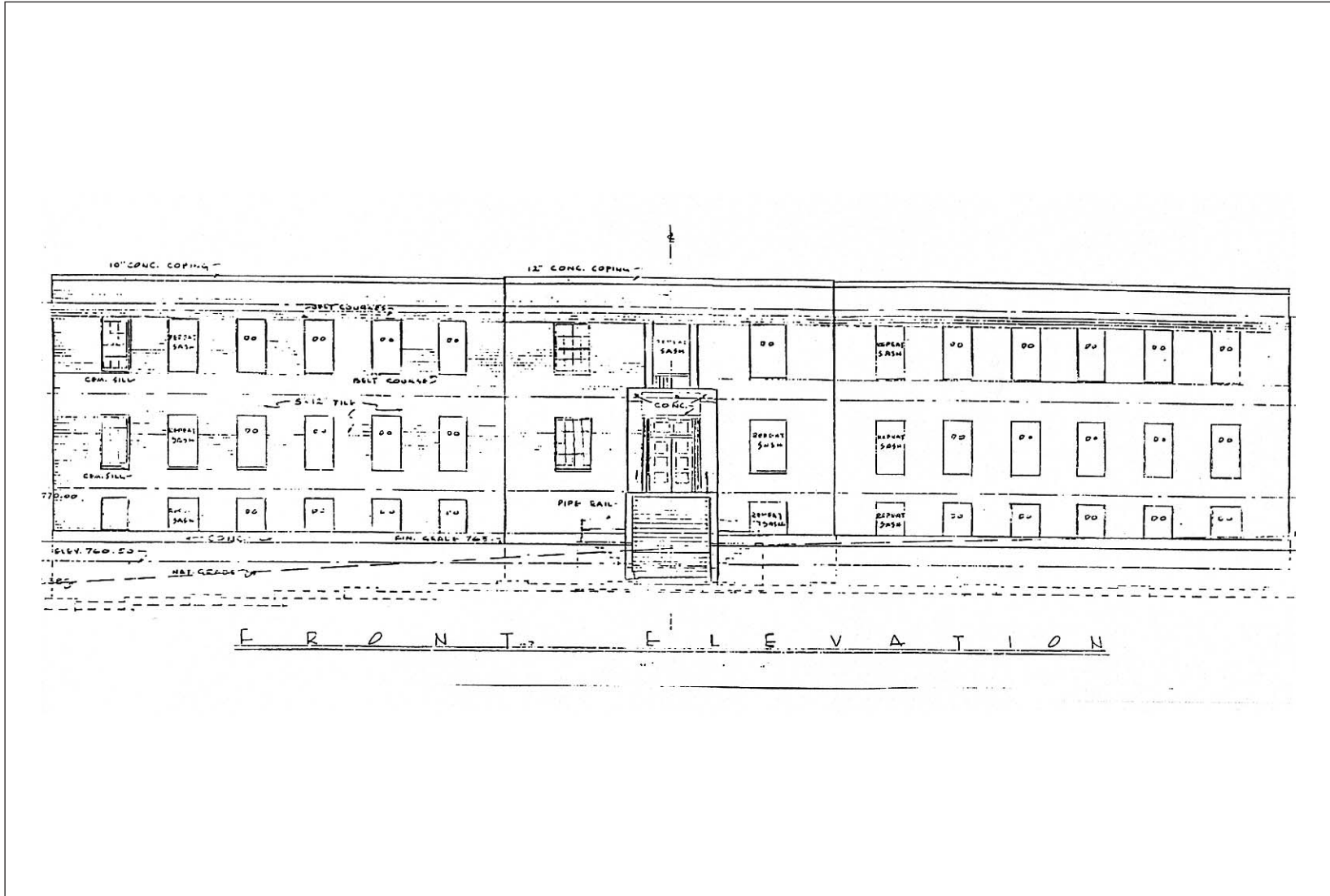


Figure 6  
Blueprint of Building 111

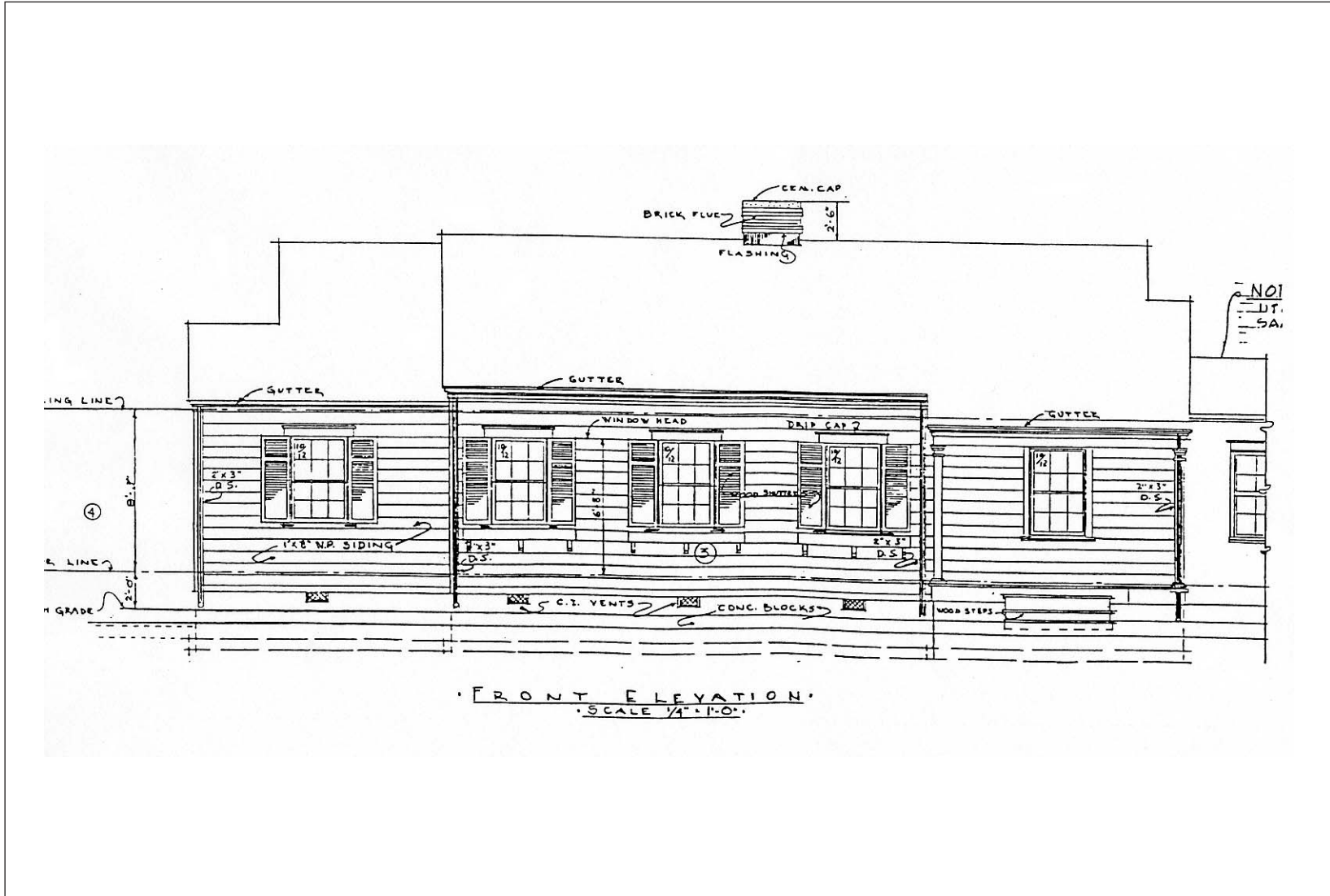


Figure 7  
Blueprint of Building 7124

indicate that the staff housing on the Huntsville Arsenal was of this design but were much larger. Although the plans are called “standard”, they do not conform to the 700 series architectural plans and it is not clear if the 800 series had a standard officers’ quarter. Perhaps WRS used the term “standard” to indicate its housing designs for both Redstone and Huntsville Arsenals.

The blueprint details a small but surprisingly stylish Colonial Revival ranch home with a side gable roof. The house is set on a concrete block foundation and clad with weatherboards. A slightly off-center interior chimney breaks the moderately pitched roofline. The homes have small entry porches supported by square columns with stylized capitals. The six-over-six sash windows were surrounded by drip moldings and featured shutters. At the rear were small screened porches.

In 1943, the administrative area consisted of the headquarters building (111), hospital (112), hospital annex (110), telephone communications, (113), fire house (114), boiler house (115), doctors’ and nurses’ mess (116), doctors’ and nurses’ quarters (118), staff quarters (55, 56, 58, 60 and 62), and a booster pump station (122), which was located some distance east on what is now Goss Road. Like all the areas on Huntsville Arsenal, the administrative area was a complete unit unto itself. Redstone Arsenal had three posts, all with administrative areas, but the Huntsville Arsenal administration area is the only one remaining.

Today, this area looks and feels much as it did in 1942 with the only real intrusions being the addition of a swimming pool on the south end of Building 111 and the covering of all the structures in metal siding. Off the staff quarters’ loop, four Wherry-Capehart bungalows were added in 1957, but their style is complimentary with the original homes. The large trees and attractive landscaping create a pleasant residential area.

**Recommendation:** It is proposed that none of the buildings in the Huntsville Arsenal Administrative Area be considered eligible to the NRHP as a district or individually under the WWII context.

Nearly all of the buildings within this group of buildings, with the exception of 115 and 122, have replacement siding over their original exteriors and many have altered fenestration. The large core buildings, (111 and 112) which were instrumental in the day-to-day operations of the post, have completely lost their classical form and many details including the belt courses, large well-proportioned windows, and their red clay tile exteriors. This grave loss of integrity prevents all of these buildings from being eligible under any criteria, and particularly under Criterion C.

To assess eligibility under Criterion B, the historical record must be examined. Earlier research indicates that the primary administrative buildings (110, 111, 112, 113, 114, 115, 116, and 118) were all constructed between 1941 to 1943. They served as the headquarters buildings for the Huntsville Arsenal and housed offices for the commanding officer, Col. Rollo C. Ditto. Some also functioned as barracks and physical plant structures such as the boiler house (115) and fire station (114). Although the activities which occurred within these buildings during World War II were, no doubt, of paramount importance to the success of the Huntsville Arsenal, they were not unique

to other CWS or Ordnance Department arsenals. The true historical significance of this installation is better represented in its production lines and factories, not in its administrative headquarters and therefore, Criterion B does not apply here.

These buildings are also not eligible under Criterion A as no one historically significant individual is represented here during the World War II period.

The other buildings listed within the administrative area are staff quarters and include building numbers 55, 56, 58, 60, and 62. These are single family homes constructed in 1942 with Colonial Revival elements—an early example of this style in Alabama. Because there are no records which show who lived in the quarters, it is impossible to assess whether they are eligible under Criterion A or B. As for significance under Criterion C, each of these houses is now covered with vinyl siding and they have also lost many of their original Colonial Revival details such as shutters and classical porch supports. These alterations significantly affect their historic integrity. Finally, these officers' quarters are of similar style and scale to those located in the Redstone Arsenal (7122, 7123, 7124, 7125, 7126, 7127, 7128, 7129, and 7130) which were declared not eligible by the ALSHPO in 1998. To make these buildings eligible while not giving their counterparts in the adjacent installation the same recognition would be inconsistent.

All buildings in the administrative area are also not recommended as eligible under Criterion D. This criteria is almost exclusively used for archaeological sites and not for buildings and structures. In order for this criteria to be applied to a building, the resource "must be, or must have been, the principal source of important information" (National Park Service 1997:21). The historical World War II information reflected in these buildings can be more readily obtained and understood in other records such as oral histories, government and military documents, photographs, and even other buildings at the Huntsville Arsenal.

**ALSHPO Comments:** The ALSHPO concurred that buildings 55, 56, 58, 60, 62, and 122 are not eligible to the NRHP under the WWII context per letter to the Redstone Arsenal's Directorate of Environmental Management dated May 18, 2001. Per letter dated July 23, 2001, the ALSHPO agreed with the report written by Historic Resource Assessments (Wright 2001) and concurred that buildings 110, 111, 112, 114, 116, and 118 are eligible to the NRHP as a district (Guided Missile Center Historic District) under the Cold War context. Buildings 109, 113, and 115 are considered to be non-contributing to this district.

### Huntsville Arsenal Airport

Table 2. Huntsville Arsenal Airport

Building Number	WWII Use	NRHP Recommendation
T4809	Airport Office Building—DEMOLISHED 1999	Not Eligible



In 1943, the airfield's original runway and first administrative building were completed at Huntsville Arsenal to accommodate the planes used to test clusters of incendiary bombs and smoke grenades. In May of that year, the first Army Forces (AAF) detachment, the 6th AAF Base Unit (Proving Ground Detachment), was stationed at the airstrip. Later, in 1944, the 618th AAF Base Unit absorbed this unit.

The CWS used the Huntsville Arsenal's test areas and ranges as the main proving ground for incendiary munitions because of the area's good climate and visibility. Munitions from across the county, both GOGOs and GOCOs, were tested at this installation. Between 1943 and 1945, Army bombers dropped more than 8 million pounds of chemical munitions at Huntsville Arsenal (Hughes 1992:2).

During the Cold War era, the airfield underwent major renovations and additions, including the construction of an air traffic control tower and modern radar and communications equipment, giving it a major airfield function. Changes have continued over the life of the field to continually upgrade the airport so that it can lend air support to Redstone Arsenal.

The sole remaining airport structure underwent major changes since its construction in 1942. It was demolished in 1999.

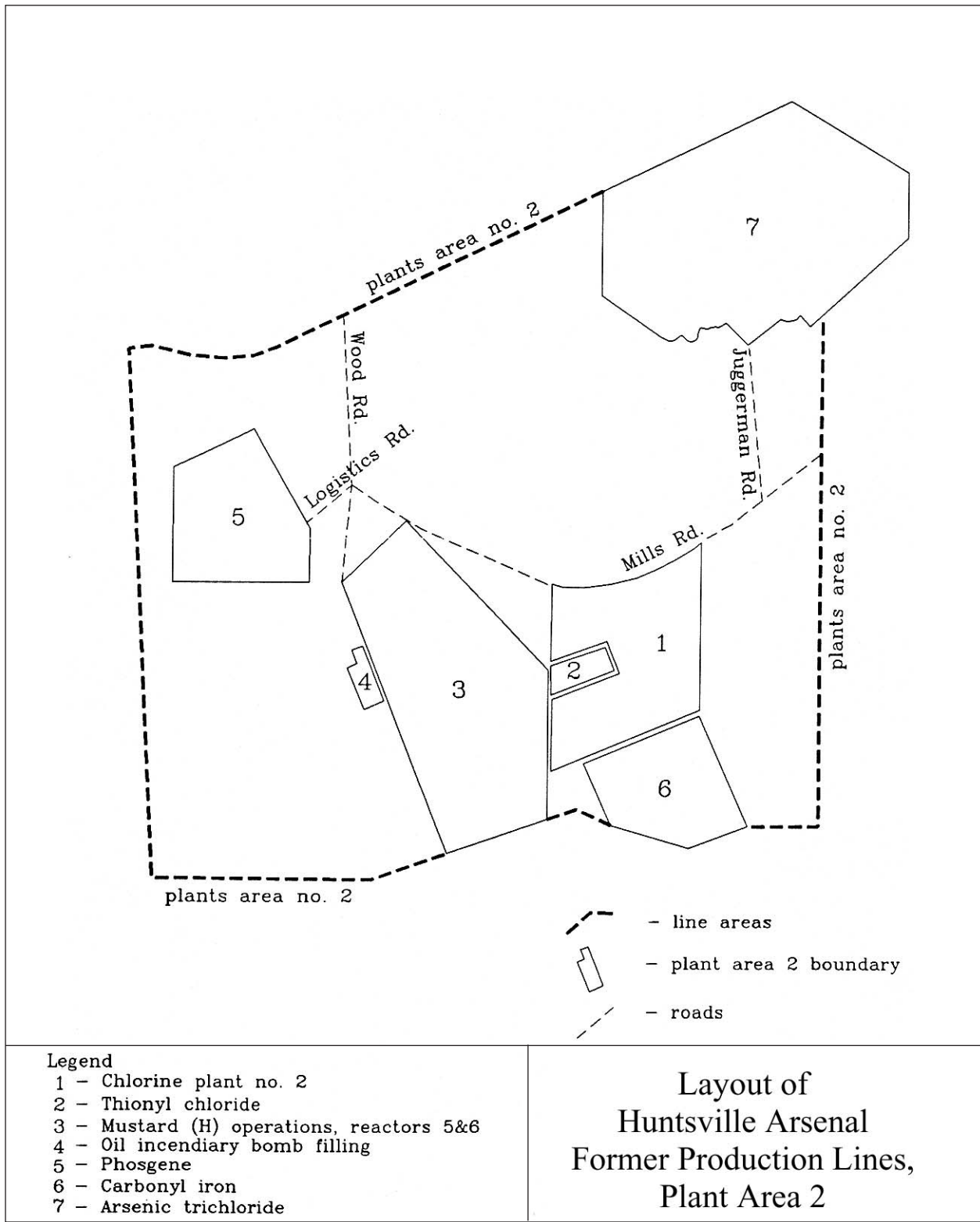
**Recommendation:** Although the airfield was an important component of the World War II history of the Huntsville Arsenal, this building is not representative of the testing activities that took place here. The Huntsville Arsenal Airport building is not considered eligible to the NRHP under the World War II context.

**ALSHPO Comment:** The ALSHPO concurred per letter dated February 20, 1998 that Building 4809 was not eligible to the NRHP under the WWII context and it was subsequently demolished in 1999.

### **Plant Areas 1 and 2**

There were two identical chemical manufacturing plants at the Huntsville Arsenal—Plant Area 1 and Plant Area 2 (Figure 8). They were set at some distance apart from one another so that one might be spared in the event of a hostile attack. The majority of Plant Area 1 is now occupied by NASA's Marshall Space Flight Center. Only the few buildings within Army control are discussed below. At both of these plants, toxic gases were created and then assembled into munitions. With the exception of the incendiary oil bomb manufacturing building (5681), these two plant areas generally did not produce smoke munitions or incendiary devices. Those weapons were created in Plant Area 3.

Figure 8  
Layout of Huntsville Arsenal Production Lines, Plant Area 2



Courtesy of Panamerican Consultants, Inc., 1998



### Huntsville Arsenal—Plant Area 1

Table 3. Huntsville Arsenal—Plant Area 1

Building Number	WWII Use	NRHP Recommendation
4381	Manufacturing Plant Office & Locker Room	Not Eligible
4424	Administration and Plant Area Fire Station #1	Not Eligible
4496	Chemical Storage Warehouse	Not Eligible
4497	Chemical Storage Warehouse	Not Eligible
4637	Sewage Treatment Plant	Not Eligible
4722	Inert Storage Warehouse	Not Eligible
4725	Boiler House	Not Eligible

All of these structures are typical of WWII building types described above and can be found all over Redstone Arsenal. Each large plant area had its own boiler house, fire station, warehouses, and manufacturing related office structures. Plant Area 1 was no different.

In previous reports, it was suggested that the buildings listed here were part of an M1 smoke pot plant. M1 smoke pots were used extensively during World War II to assist in large area smoke screens. They were assembled in the Smoke Munitions Filling Plant 1 in Plant Area 3, not here in chemical Plant 1. A smoke pot filling plant would have been made up of screening and weighing buildings, mixing buildings, application buildings, fill and press structures, painting and packing buildings, chemical buildings, and warehouses (Nolte 1998:42, *The History of the Huntsville Arsenal* n.d.:545). Even if M1 smoke pots were created here for a short period of time, the only manufacturing building listed here (4381) was an office and locker room and not an actual production facility. It has also been radically altered with modern metal siding.

The other structures remaining here are administrative (4424), storage facilities (4496, 4497, 4722) or infrastructure buildings (4637, 4725) and do not represent a chemical production process and are not tied to any one line. They, therefore, lack historic importance. With the exception of Buildings 4496, 4637, and 4725, which are unchanged, modern siding and additions have affected their historic integrity. Furthermore, this group of buildings as a whole, is scattered over a large area with a multitude of non-historic buildings placed in between them making a continuous historic district or one without a disproportionate number of post-World War II structures, essentially impossible. The NRHP guidelines state that a historic district may contain discontinuous structures when “visual continuity is not a factor of historic significance;...manmade resources are interconnected by natural features;...or a portion of a district has been separated by intervening development...and the separated portion has sufficient significance and integrity” (National Park Service 1997:57). In this case, the intervening development does not have sufficient significance or integrity as it is less than fifty years old and does not at all relate to the World War II mission of the Huntsville Arsenal.

A couple of the buildings, however, are significant for their association with the Cold War. Local informants believe that Building 4722 was the site of one of Von

Braun's offices and labs and that active rocket testing was carried out on the broad expanse of lawn behind the structure (Nolte 1998:39).

**Recommendation:** The seven buildings listed in Plant Area 1 are not recommended as eligible to the NRHP under the World War II context because of their lack of historical importance, alterations, and scattered locations.

**ALSHPO Comments:** Per letter of concurrence dated May 18, 2001, the ALSHPO agreed that buildings 4424, 4496, 4497, 4637, and 4725 are not eligible to the NRHP under the WWII context. Buildings 4381 and 4722 were recommended as eligible to the NRHP under the Cold War context by letter of concurrence dated July 23, 2001. Building 4722 was reevaluated by Lauren McCroskey, USACE, Seattle District. The ALSHPO concurred that due to the loss of integrity, 4722 is not eligible under Exception G in the Cold War context.

### Huntsville Arsenal—Plant Area 2: Miscellaneous Buildings

Table 4. Huntsville Arsenal—Plant Area 2: Miscellaneous Buildings

Building Number	WWII Use	NRHP Recommendation
5412	Maintenance Shop	Not Eligible
5414	Fire Station	Not Eligible
5420	Control Analysis Laboratory	Not Eligible
5425	Warehouse	Not Eligible
5451	Office and Locker Room, DEMOLISHED 1999	Not Eligible
5631	Storage Tank	Not Eligible
5687	Warehouse	Not Eligible
5688	Inert Storage Warehouse	Not Eligible

Like the buildings in Plant Area 1, these are a group of unrelated, miscellaneous buildings, which served storage (5425, 5631, 5687, 5688), administrative (5451), maintenance (5412), and infrastructure (5414) purposes and do not represent a production line. The specific function of the control analysis lab (5420) is unknown, but the building has been severely altered and lacks integrity. Most of these other buildings, except for 5424 and 5631, also have modern metal siding and other alterations.

**Recommendation:** The eight miscellaneous buildings listed in Plant Area 2 are recommended as not eligible to the NRHP under the World War II context.

**ALSHPO comments:** The ALSHPO concurred with this recommendation per letter dated May 18, 2001 to the Redstone Arsenal's Directorate of Environmental Management. The ALSPO also issued a letter of concurrence on February 20, 1998 agreeing that building 5451 was ineligible to the NRHP and it was therefore, demolished.

## Huntsville Arsenal—Plant Area 2: Lewisite Buildings

Table 5. Huntsville Arsenal—Plant Area 2: Lewisite Buildings

Building Number	WWII Use	NRHP Recommendation
5421	Office and Locker Room	Not Eligible
5429	Manufacturing Building	Not Eligible
5432	Sulfur Monochloride Building	Not Eligible
5436	Extension Warehouse	Not Eligible
5437	Extension Warehouse	Not Eligible
5452	Manufacturing Plant	Not Eligible
5458	Acetylene Scrubber Building	Not Eligible

Previous reports labeled these structures as M1 (smoke pot) production buildings, but their ultimate use may have been quite different (Nolte 1998:41). As stated in reference to supposed M1 buildings in Plant Area 1, smoke pots were produced in the smoke munitions filling area of Plant Area 3 and not here in the chemical manufacturing sections, according to the Huntsville Arsenal history. The names of two of these buildings, in fact, have no relationship to M1 production, but instead to the manufacture of the toxic gas Lewisite. It may be possible that the smoke pots were filled here when quotas needed to be met and Lewisite production had ceased.

Lewisite was first manufactured at the Huntsville Arsenal in November 1942, and by May 1943, three other plants were in operation. It was also produced at the Pine Bluff and Rocky Mountain facilities. Lewisite was not considered as valuable as mustard gas because it possessed a stronger smell and caused immediate eye pain that quickly alerted troops to its presence (Freeman 1991:34). Gas masks also provided complete protection, it could be easily decontaminated, and there was difficulty in getting the right concentration on the field. As a result, the Army decided to close all the Lewisite plants in 1943 after 20,000 tons had been produced (Brophy et al. 1988:68). At the Huntsville Arsenal, production of Lewisite ceased at the end of October 1943, and it was declared surplus in 1944 (Joiner 1966:31). Of the six plants constructed at the Huntsville Arsenal, two were never activated (*History of the Huntsville Arsenal* n.d.: 436).

Lewisite is made from two different chemicals, thionyl chloride (TC) and arsenic trichloride. The TC plant was adjacent to the carbonyl iron unit and chlorine Plant 2, but no buildings remain from it. The arsenic trichloride manufacturing area included this group of buildings and consisted of an arsenic trichloride reactor, a sulfur monochloride plant, an acetylene building and scrubber, and a sulfur dioxide disposal system (Joiner 1966:31 and *History of the Huntsville Arsenal* n.d.:436). Of the structures remaining here, buildings 5432 (sulfur monochloride building) and 5458 (acetylene scrubber) clearly had Lewisite functions. Two others, 5429 and 5452, may have also served manufacturing purposes, but research did not divulge their exact mission.

**Recommendation:** Despite the fact that these are the only Lewisite production buildings at the Huntsville Arsenal, only building 5458 remains unaltered without modern metal siding. In addition, the older buildings are overpowered by surrounding new construction that has altered the historic setting of the extant resources associated with Lewisite production. Given this, the Lewisite buildings in Plant Area 2 are not considered eligible to the NRHP under the World War II context.

**ALSHPO Comments:** The ALSHPO concurred with this recommendation per letter dated May 18, 2001 to the Redstone Arsenal's Directorate of Environmental Management.

### Huntsville Arsenal—Plant Area 2: Carbonyl Iron Unit

Table 6. Huntsville Arsenal—Plant Area 2: Carbonyl Iron Unit

Building Number	WWII Use	NRHP Recommendation
5561	Carbonyl Iron Unit, ICY Towers	Eligible
5562	Compressor	Eligible
5563	Decomposition Building	Eligible
5564	Hydrogen Building	Eligible
5565	Office Building and Labs	Eligible
5566	Iron Preparation Building	Eligible
5567	Carbon Monoxide Generating Building	Eligible
5572	Carbon Monoxide Generating Building	Eligible

During WWII, the Signal Corps used carbonyl iron (CI) in their radar equipment and radios to improve tuning and reception. Radar signals played an essential role in the war's pivotal battles such as the D-Day invasion at Normandy. Significant radar applications included guiding night fighters so that enemy planes could be intercepted, navigating bombers to their targets, and assisting paratroopers to landing zones. The Allies' experiences with radar against the Italians, in desert campaigns, and in D-Day brought greater refinements to radar technology.

During World War II, radar technology was also important to the expanding role of military aircraft. Previously viewed as support to ground and sea forces in the delivery of ordnance and equipment, air forces took on a central role in attacking enemy sites. Through strategic air bombing of factories, bases, and infrastructure, the opponent's ability to wage war was greatly reduced. Precision air strikes on German transportation and petroleum supplies became a hallmark of Allied successes, and further defined the growing superiority of American military technology.

But these air missions were only as effective as the technology that guided their way. Because radar technology demanded great accuracy, any enhancement to the system could make the difference between victory and failure. A key improvement to radar performance was made using carbonyl iron (CI). It had been discovered that small CI pellets, compressed into cores and fitted into radar units, greatly improved the

transmission of radar and radio signals. The CI cores were composed of finely reduced particles of iron that were insulated from one another, but pressed together with a binding compound. The iron powder and binding compound were mixed and compressed under heavy pressure, then baked at high temperature. The high temperature stability of CI made it suitable for radio frequency applications where good stability and range were essential. Today, CI cores are highly desirable for narrow band filter inductors, tuned transformers, oscillators and tank circuits, and are very much in demand for broadband inductors, especially where high power is concerned (McCroskey 2002b).

Only a few CI plants existed in the U.S. in the 1940s. The CI facility at Huntsville Arsenal was created to serve solely as a standby plant in the event that the only other operating plant, then controlled by General Aniline Works at Grasselli, New Jersey, be destroyed. The Huntsville Arsenal plant was constructed by H. K. Ferguson Company, Cleveland, Ohio, and was designed by General Aniline using equipment from a dismantled Shreveport, Louisiana CI plant. General Aniline was retained to render technical assistance until the Huntsville facility was put into successful production.

Like the FRED project, the production of carbonyl iron powder was one of the unique missions undertaken by CWS during World War II. The goal at the Huntsville Arsenal during WWII was to manufacture 125,000 pounds of CI and then remain in standby status should more be needed. The plant went into production on July 9, 1943, and completed its mission on October 16, 1943.

Located in Plant Area 2 near Chlorine Plant 2, from which it obtained the hydrogen necessary for its processes, the CI plant had a daily capacity of 1,500 pounds (Figure 9). Detailed site plans and building blueprints show that the entire plant totaled only 100 square yards (*History of the Huntsville Arsenal* n.d.).

All of the CI plant's equipment and floor plans were duplicates of the General Aniline Works New Jersey site (Huntsville Arsenal ca. 1945). An Army officer served as the plant superintendent, and all workers, both civilian and military, were trained at the New Jersey plant.

The principal items of operating equipment included:

Equipment for manufacture of iron carbonyl, which included transfer chute, carbonyl towers, preheater, percoolers, condenser, separators, sludge tank, iron carbonyl storage tank, pumps, calcium chloride dryers, carbon monoxide gas holder, autoclaves, compressors, and a flare for burning waste gases.

Equipment for decomposing iron carbonyl comprising measuring tanks, feed pumps, feed tanks, evaporators, decomposers, decomposer furnaces, magnetic separators, bag filters, carbon monoxide gas scrubber, and a water separator.

Equipment for finishing carbonyl iron, which was comprised of drum hoists, prescreener, ball mill, screener, mixer, and drum filling machine.

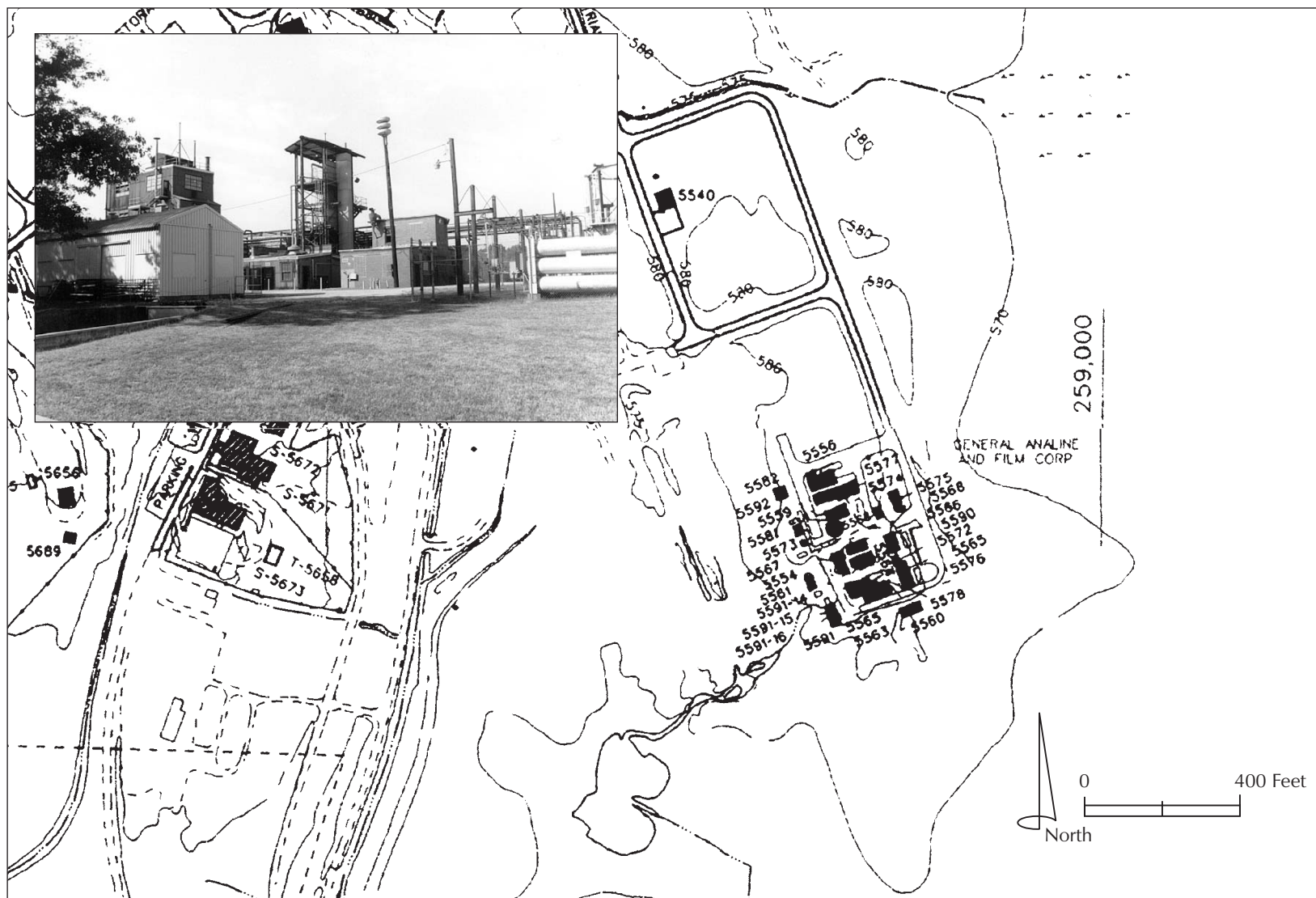


Figure 9  
Carbonyl Iron Unit Historic District and View

Equipment for manufacture of carbon monoxide (located at the Phosgene Plant where it served a dual purpose), which consisted of liquidors, carbon dioxide storage tanks, carbon monoxide generator, blowers, scrubbers, and filters.

Ammonia system equipment consisting of an unloading station, ammonia receiver, ammonia vaporizer, nitrogen unloading station, and nitrogen compressor (*History of the Huntsville Arsenal* n.d.).

The plant consisted of approximately fourteen buildings of varying types: two large gas holding tanks, one carbon monoxide (CO) and the other hydrogen; a number of smaller holding tanks, below and above ground; a gas burn-off pit to the northwest; and a railroad spur running along the plant's east side. The typical industrial structures were built primarily of construction tile with flat or side gabled roofs. Blueprints for Building 5562 (compressor building) and Building 5566 (iron preparation building) show similar styles for both types of production buildings (Figure 10).

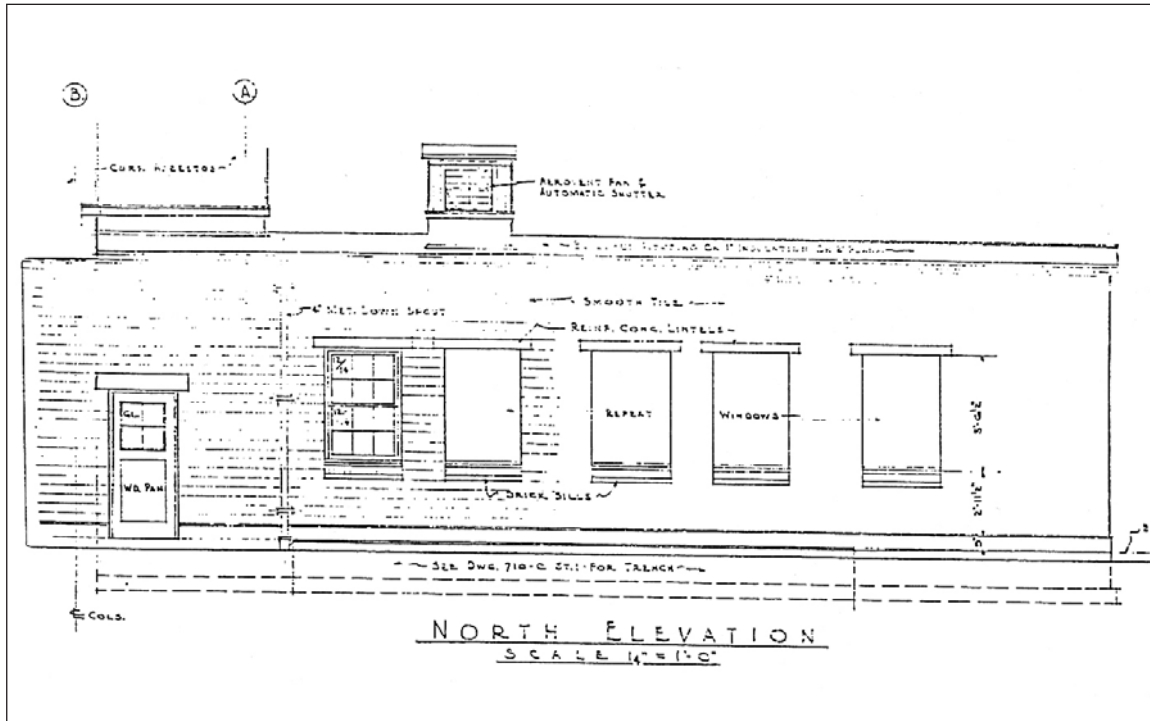
After World War II the plant was turned into a GOCO (government owned, contractor operated) facility and leased to the GAF Corporation. GAF, now known as International Specialty Products (ISP) (a division of General Aniline), continues to operate the plant and sells the iron powder on the open commercial market. Today the CI plant looks much the same as it did in WWII. With its original equipment, the plant continues to manufacture iron pellets that are used in everything from vitamin pills to fertilizer. It is the only active CI plant in the northern hemisphere and one of three in the world (Redstone Arsenal Command Historian Office, historical files).

**Recommendation:** The carbonyl iron unit is considered eligible as a NRHP district under Criteria A and C. Although it saw little output in World War II, the buildings and equipment, which were constructed during that period, still remain with few alterations. Carbonyl iron was a necessary component in the war effort and unlike the toxic gases, was used in combat. The historic CI district at Redstone Arsenal reveals the wartime importance of radar and radio operations, and the commitment to perfecting a system that was crucial in many battles.

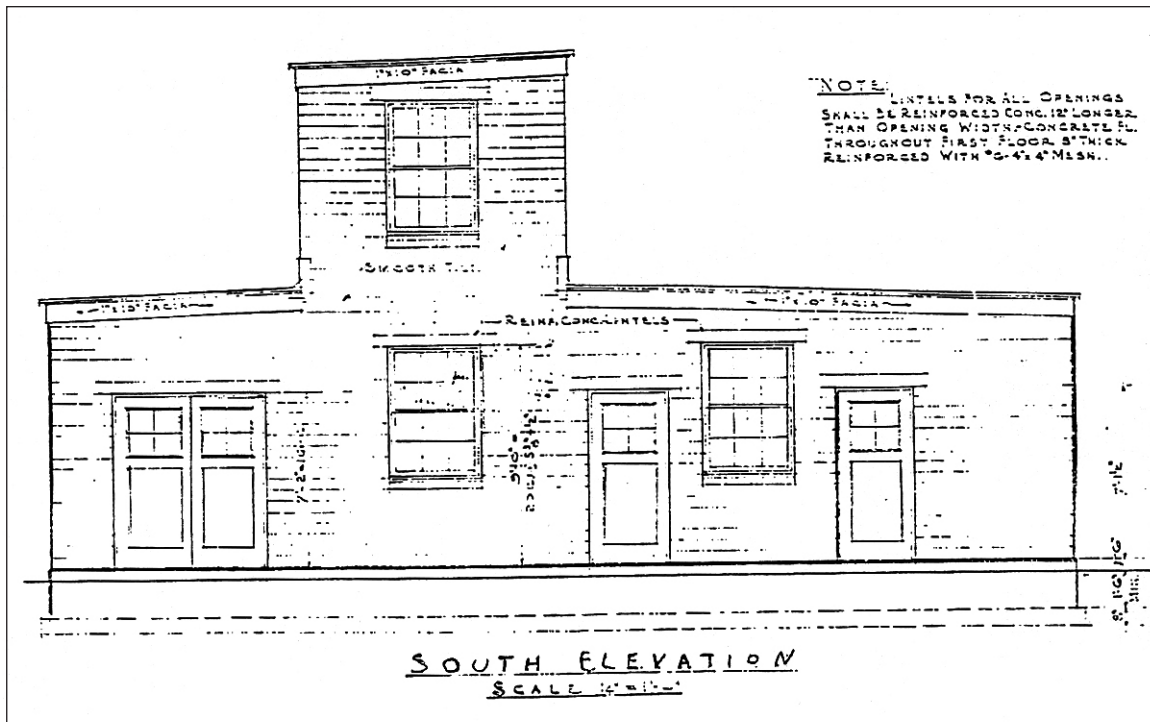
The district is eligible under Criterion C because it is an example of a manufacturing process, which requires unique structures, and buildings of which only three exist in the world. The district should include all of the buildings listed above. They are set apart from all other manufacturing facilities in Plant Area 2 and include no modern construction intrusions.

**ALSHO Comments:** Per letter dated May 18, 2001, the ALSHPO concurred that all of these CI buildings are eligible to the NRHP under the WWII context.

Figure 10  
Blueprints of Carbonyl Iron Unit Buildings 5562 and 5566



A. CI plant, detail of compressor building, Building 5562 (H. K. Ferguson 1943).



B. CI plant, detail of iron preparation building, Building 5566 (H. K. Ferguson 1943).



## Huntsville Arsenal—Plant Area 2: Chlorine Plant 2

Table 7. Huntsville Arsenal—Plant Area 2: Chlorine Plant 2

Building Number	WWII Use	NRHP Recommendation
5577	TC Drum Loading Building	Not Eligible

Huntsville Arsenal had two chlorine plants, one in Plant 1 and the other in Plant 2. Preliminary operations at the two plants began in May 1942 and continued until July 1945. Their purpose was to produce chlorine for the manufacture of mustard gas and Lewisite.

In 1946, both chlorine plants were leased to the Solvay Process Division of the Allied Chemical and Dye Corporation of Solvay, New York, for the production of chlorine. The first Solvay plant began operations on December 14, 1946, and the other in May 1947. Later it was leased to the Olin Chemical Corporation and used in the manufacturing of DDT.

The H. K. Ferguson Company, Engineers, built the chlorine plants. Blueprints indicate that a railroad spur #10 ran from Building 5577 (the TC drum loading building) to Building 5564 (the hydrogen furnace and composition building) in the TC area (Blueprint #7120-709). Building 5577 is the sole remaining chlorine building from both Plants 1 and 2 (Nolte 1998:49).

**Recommendation:** Although Building 5577 is the last chlorine building, it served simply as a shelter over the railroad track running between this thionyl chloride (TC) drum loading building and the hydrogen furnace and composition building in the TC plant. The building does not represent the entire chlorine or TC production line since it only served as a loading facility. Chemicals were not manufactured here nor were any chemicals loaded into any munitions in this building. Furthermore, the building has been significantly altered and is now clad with corrugated metal siding. Given this, the TC drum loading building is not considered eligible to the NRHP under the World War II context.

**ALSHPO Comments:** The ALSHPO concurred with this recommendation per letter dated May 18, 2001 to the Redstone Arsenal's Directorate of Environmental Management.

## Huntsville Arsenal—Plant Area 2: Mustard Gas (H) Line

Table 8. Huntsville Arsenal—Plant Area 2: Mustard Gas (H) Line

Building Number	WWII Use	NRHP Recommendation
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<b>Number</b>		
5661	H Reactor Unit	Eligible
5662	Sulfur Monochloride Building	Eligible
5663	Ethylene Generator Building	Eligible
5664	(Tail) Gas Scrubber	Non-Contributing/Not Eligible
5666	HS Scrubber and Disposal Reactor	Eligible
5668	Chlorine Warehouse	Eligible
5669	Chlorine Warehouse	Eligible
5670	Chlorine Warehouse	Eligible
5671	H Reactor Building	Eligible
5672	Sulfur Monochloride Building	Eligible
5673	Ethylene Generator Building	Eligible

In July 1917 the German Army began using a new type of toxic agent, mustard gas, on the battlefield. It attacked the respiratory system and the skin as it soaked clothing and shoes raising painful blisters and burns. It could also cause vomiting, prostration, and even death. Several hours passed before symptoms appeared and it was virtually impossible to shield soldiers completely from it. Mustard gas evaporated slowly and remained effective from several hours to several days, depending on the weather and terrain. Because of its persistence it could be used to “seal off” an area into which enemy troops were advancing or contaminate routes in the event of a withdrawal. Mustard gas was the “king of battle gases”, causing more than 400,000 casualties before the armistice.

Crude mustard gas (H) was a mixture of approximately 70 percent dichloroethyl sulfide and 30 percent sulfur and other sulfur compounds. The gas was actually an oily brown liquid that evaporated slowly giving off a vapor that was heavier than air. In ordinary field conditions it was odorless, but in high concentrations it smelled like garlic or mustard, hence its name. The CWS adopted the British Levinstein process of creating mustard gas in which ethylene reacted with sulfur monochloride under carefully controlled conditions. Unfortunately, this process caused the gas to quickly corrode containers making storage unsafe. When the filled mustard components were sent to be fused, burstered, and packed at the Redstone Arsenal, many leaked on the way to the plant or on the line, causing contamination problems that resulted in production stoppages and injuries. Later in WWII, a new distillation process was developed, but the Huntsville Arsenal used the Levinstein process throughout its production years (Nolte 1998:50-51).

During World War II, mustard gas was used in a jelly-like form and could be delivered by ground troops using the 4.2-inch chemical mortar shells, artillery shells, and land mines. For aerial mustard attacks, pilots could drop chemical bombs and spray tanks. The gas was, however, never used in combat, but was the preferred chemical weapon in the event of such warfare because it was not easily detectable and sufficiently debilitating. Mustard gas was produced in vast amounts and stockpiled in quantities greater than any other toxic agent. The plants at Edgewood, Huntsville, Pine Bluff, and Rocky Mountain Arsenals produced 174,610,000 pounds of mustard gas using the Levinstein process and another 9 million pounds of distilled mustard gas (Brophy et al. 1988:65).

At the Huntsville Arsenal, mustard gas was produced at six separate plants beginning in March 1942. The first four facilities were located in Plant Area 1 in what is now the Marshall Space Flight Center. Plants 5 and 6 were in Plant Area 2 and began operation on September 20, 1942 and November 22, 1942 respectively. Although all mustard gas facilities were all shut down in May 1943, Plants 5 and 6 were reactivated in October 1944 to produce fill for M70 bombs. Formally deactivated in June 1945, the two plants were called into production again in August to complete an order of 5,556 additional M70 bombs, probably in response to the government's serious consideration of using chemical weapons in the Pacific Theater.

Each plant was initially designed to manufacture 24 tons of H per day. It was discovered that they could produce almost twice that amount, making the total capacity of all six plants 240 tons per day or 7,200 tons per month. A fortuitous discovery involving the increased concentration of sulfur monochloride and peak ethylene consumption shortened the reactor time considerably, thereby greatly enhancing product output. All six plants used this production formula (*History of the Huntsville Arsenal* n.d.).

The mustard gas was loaded into a variety of weapons at the Redstone Arsenal. The first item filled was the 105 mm M-60 artillery shell—the most commonly produced chemical artillery shell with 1,983,945 readied by the CWS during the war. The 115-pound M-70 bomb, developed by the Ordnance Department beginning in October 1944, was also manufactured during World War II at Huntsville. Other bombs included the 100-pound M47A2 developed by the CWS in the 1930s and first created at Huntsville in October 1942 and the MK42, a Navy bomb of which 11,856 were made beginning in January 1943, and 4.2-inch mortars (Joiner 1966:30 and Brophy et al. 1988:65).

The design of mustard gas plants was modeled after the CWS “Levinstein HS Plant-1941 Design.” All the plants were identical and occupied a space about 400-x-600 ft. including the parking lots. Each H plant was composed of a sulfur monochloride building, an ethylene generator building, an H reactor building, two 50,000 cubic foot capacity gas holders, a tail gas scrubber building, a disposal reactor, a lunchroom, and several accessory structures, such as warehouses (*History of the Huntsville Arsenal* n.d.) (Figure 11).

Plants 5 and 6 remain as intact examples of a mustard gas manufacturing facility. Aside from the gas holders and the lunchroom—buildings which were perhaps least important to production, there are examples of each component of a mustard gas manufacturing facility here. Unlike other areas of the Arsenal, this area contains a nearly complete production line (Figure 12).

The buildings in Plant Area 2 also still closely resemble the original structures. They were constructed of steel girders with roof and siding of corrugated APM, or asphalt protected metal—the same material which remains on all of these buildings except 5664, the tail gas scrubber building which has been re-sheathed with modern metal siding. The interiors are partitioned with hollow clay tile walls (*History of the Huntsville Arsenal* n.d.: 324). A few buildings like 5671 have small additions, but for the most part, the exteriors are unchanged. The hollow clay tile warehouses (5668, 5669, 5670) also remain unaltered (Figures 13 and 14). All of the buildings, however, have

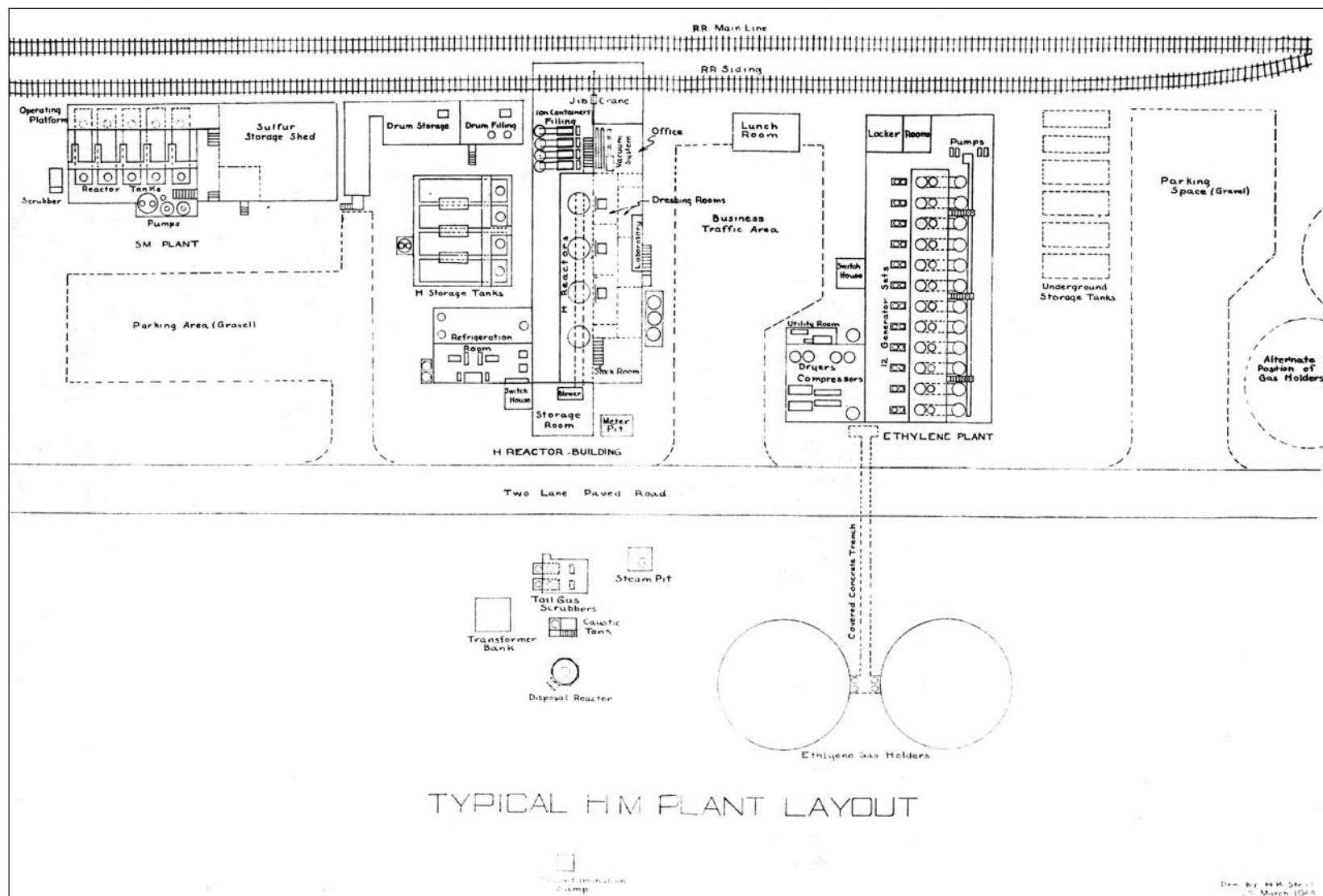


Figure 11  
Layout of Mustard Gas Plant





Figure 13  
Mustard Gas Historic District Photographs



Mustard Gas Buildings Nos. 5671, 5672 and 5673.



Building No. 5661, Mustard Gas Reactor Unit.



Mustard Gas Warehouse Building 5670.

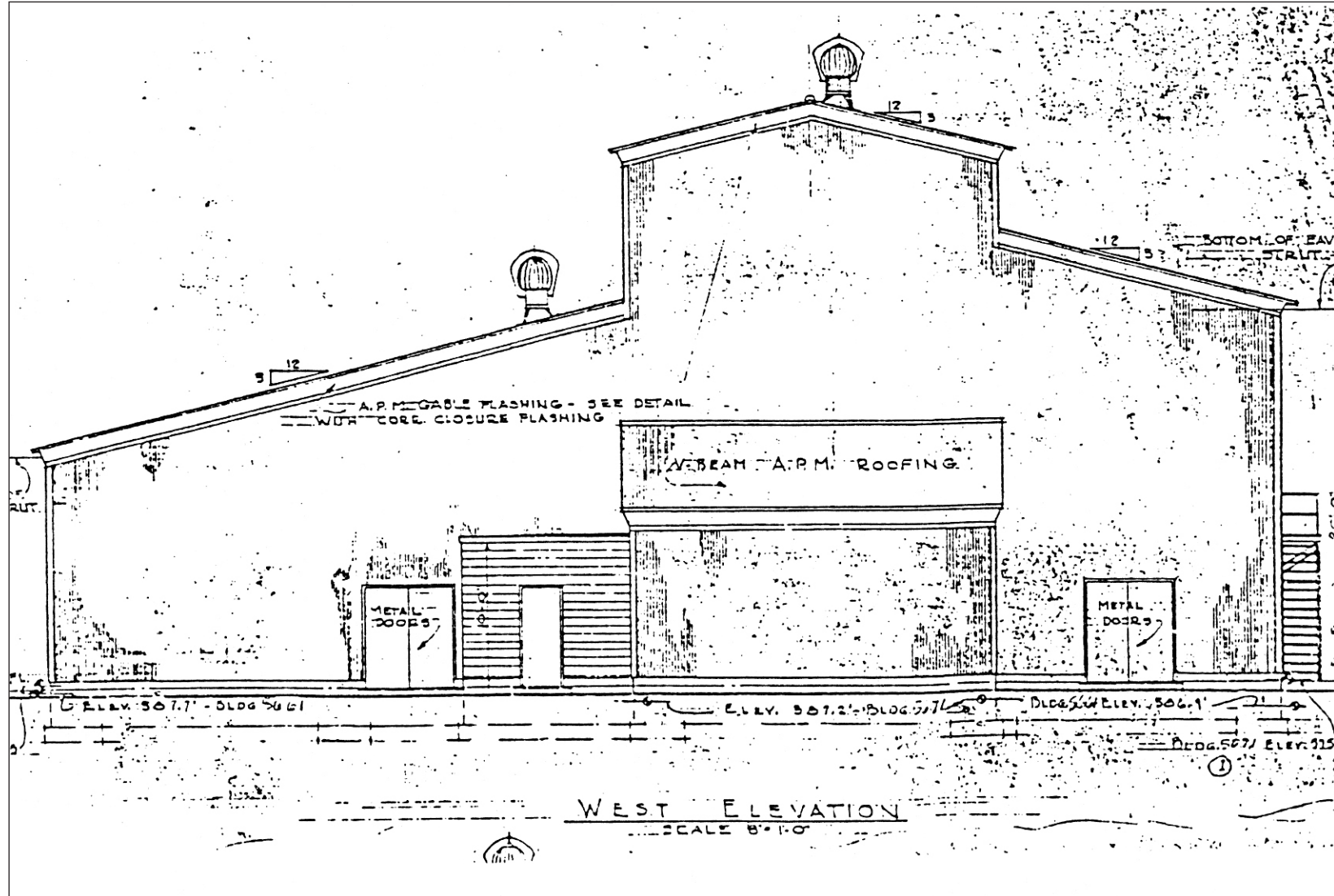


Figure 14  
Blueprint of Mustard Gas Building 5671

been converted to other uses since World War II. These buildings are also continuous, unlike the other plant areas, and there are no non-historic building intrusions within the group.

**Recommendation:** The mustard gas buildings in Plant 5 and 6 are considered eligible to the NRHP as a district under Criteria A and C. They represent an important manufacturing process that was once evident in six different plants within the Arsenal, of which only two remain. Unlike other production lines, the buildings, which constitute an entire manufacturing process, are still intact and unaltered. They are also contiguous with no modern intrusions making a historic district easy to define. Although mustard gas was not used in combat, it was the most important of the toxic gases stockpiled and was a principle product of the Huntsville Arsenal during World War II. The district should include all of these buildings with 5664 considered non-contributing because of its loss of integrity.

**ALSHPO Comments:** The ALSHPO concurred with this recommendation per letter dated May 18, 2001 to the Redstone Arsenal's Directorate of Environmental Management.

### Huntsville Arsenal—Plant Area 2: Phosgene (CG) Plant

Table 9. Huntsville Arsenal—Plant Area 2: Phosgene (CG) Plant

Building Number	WWII Use	NRHP Recommendation
5415	Inert Storage Warehouse	Not Eligible
5423	Inert Storage Warehouse	Not Eligible
5424	Inert Storage Warehouse	Not Eligible
5480	Inert Storage Warehouse	Not Eligible
5485	Inert Storage Warehouse	Not Eligible
5487	Inert Storage Warehouse	Not Eligible
5488	Inert Storage Warehouse	Not Eligible
5489	Inert Storage Warehouse	Not Eligible
5675	Carbon Monoxide Manufacturing Plant, DEMOLISHED 1998	Not Eligible
5676	Catalyzer Building, DEMOLISHED 1998	Not Eligible
5678	Coke Storage Building	Not Eligible
5685	Inert Storage Warehouse	Not Eligible

Carbonyl chloride or phosgene (CG), was the second major agent to appear in WWI. A vapor that smells like green corn or new mown hay, phosgene is extremely toxic. When inhaled, CG damages the capillaries in the lungs allowing a watery fluid to seep into the air cells. If the quantity inhaled is small, the water is reabsorbed and the cell wall heals, but if the quantity is large, the air cells become flooded and death occurs from lack of oxygen. The full effect of the poisoning is not apparent until three or four hours after exposure. Of all nonpersistent agents developed during WWI, none were more effective than CG. This extremely dangerous agent is estimated to have caused more than 80 percent of all WWI chemical fatalities (Brophy et al. 1988:51).



During WWII the CWS manufactured and purchased from private industry more than 40 million pounds of phosgene. The gas was then placed in various munitions. Two of the most commonly manufactured products were the 4.2-inch mortar shells and the portable cylinder. From 1941 to 1944, the CWS filled approximately half a million 4.2-inch mortar shells with CG (Brophy et al. 1988:54).

CG is prepared by combining chlorine and carbon monoxide in the presence of a catalyst. Two methods were used for carrying out the reaction: using carbon monoxide gas or diluted gas. The creation of CG required the use of solid carbon dioxide, pure oxygen, refrigeration equipment, and gas compressors. CWS chose the carbon monoxide gas reaction and in 1937 rehabilitated their old CG plant at Edgewood Arsenal. Further improvements led to increased efficiency and the development of a pilot plant. This new, improved plant served as the model for the erection of Huntsville Arsenal's 30-ton-a-day capacity plant (Brophy et al. 1988).

At the Huntsville Arsenal, the only phosgene production plant began operations in February 1944 and continued through January 1945. At the filling plant, only fifty yards away, the chemical was loaded into M-78 (500 pound) and M-79 (1,000 pound) bombs which were both new weapons developed during World War II (Redstone Arsenal website). The M-78s were manufactured for less than two weeks in April 1944, however, the M-79s were constructed from April 1944 to January 1945 (Joiner 1966:32). Upon impact, these weapons released a large amount of phosgene in a low, pancake-shape that stayed low to the ground in any weather condition—a necessary component of a successful chemical weapon. The CWS filled 25,000 M-78s in 1944 and 63,000 M-79s from 1943 to 1945. They were intended to be used on targets beyond mortar range, on islands before amphibious assaults and against other strategic military objectives. Had gas warfare begun in World War II, phosgene would have been widely used by Allied and Axis armies (Brophy et al. 1988:51-55).

The CG plant at the Huntsville Arsenal was located in Plant Area 2 not far from the H production areas. It was designed in a pentagonal shape and included a CO generating plant, a container filling shed, a catalyzer building, a dry ice building, and various storage buildings and tanks as well as offices and support facilities. The adjacent filling plant had six filling stations, each capable of filling forty bombs per eight-hour shift (Building Technology, Inc. 1984).

All of the remaining CG buildings are related to storage. The eight warehouses are standard WWII side-gable structures that can be found all over Redstone Arsenal. Like so many of the others, they have been changed drastically over time. The smaller dry ice and coke storage buildings are also common types described previously.

The dry ice storage facility was constructed at the CG plant for the cost of \$8,132 in 1943. The Engineering Service Division at Huntsville Arsenal allocated funds and they completed work since WRS 's contact had expired (*History of the Huntsville Arsenal* n.d.).

The two manufacturing buildings (5675 and 5676), that were demolished in 1998, were also typical and based on the Edgewood Arsenal model. Prior to their demolition,

they had been extensively remodeled. Unfortunately, not enough of the production line remains to provide any real information on the manufacturing sequence.

**Recommendation:** Although a potentially potent chemical weapon, phosgene was never used in combat during World War II. Operating for only eleven months, the plant was originally made up of a carbon monoxide-generating plant, a catalyst building, a ton-container filling shed, various storage tanks, and an office and locker building. Because Buildings 5675 and 5676 were demolished in 1998, none of the buildings remaining at the Arsenal were involved in the actual process of producing phosgene gas. Aside from building 5685, all of the remaining buildings have some sort of alterations mainly in the form of modern metal siding.

As the principal manufacturing buildings are no longer extant and the remaining buildings associated with phosgene production were used for non-manufacturing purposes, the surviving buildings are not recommended eligible under the World War II context.

**ALSHPO Comments:** ALSHPO concurred that Buildings 5675 and 5676 were not eligible to the NRHP under the WWII context per letter dated February 20, 1998. Both buildings were demolished later that year. The ALSHPO further concurred that Buildings 5415, 5423, 5424, 5480, 5485, 5487, 5488, 5489, 5678, and 5685 are not eligible to the NRHP under the WWII context per letter dated May 18, 2001 to the Redstone Arsenal's Directorate of Environmental Management.

## Huntsville Arsenal—Plant Area 2: Incendiary Oil Bomb Plant

Table 10. Huntsville Arsenal—Plant Area 2, Incendiary Oil Bomb Plant

Building Number	WWII Use	NRHP Recommendation
5681	Incendiary Oil Plant	Not Eligible

Previous reports incorrectly labeled this building as part of the phosgene plant. It is, however, listed in the Huntsville Arsenal history as well as in the original WRS building plan as the oil incendiary bomb plant.

Although most of the incendiary weapons were filled and assembled in Plant Area 3, this building was an exception. Originally designed to serve as part of a mustard gas filling line, as it is adjacent to the mustard gas manufacturing buildings, Building 5681 never served that purpose. In early 1943, it was converted into a large production facility for incendiary oil weapons. The 720 x 150 foot structure was made of reinforced concrete and tile and divided into five sections for storage, manufacturing, filling, and strapping. Adjacent to the building were two gasoline pumphouses, two gasoline storage tanks, three magazines, and warehouses. Within this building all M47A2, M69, and M76 incendiary bombs produced at the Arsenal were manufactured (*History of the Huntsville Arsenal* n.d.:609).

The building has since been severely altered into an administration office and in no way resembles the original structure.

**Recommendation:** The incendiary oil plant is not eligible to the NRHP under the World War II context due to its lack of integrity.

**ALSHPO Comments:** Per letter dated May 18, 2001, the ALSHPO concurred that the Incendiary Oil Bomb Plant is not eligible to the NRHP under the WWII context.

### Huntsville Arsenal—Plant Area 2: Bulk Gas/Oil/Alcohol Tank Farm

Table 11. Huntsville Arsenal—Plant Area 2: Bulk Gas/Oil/Alcohol Tank Farm

Building Number	WWII Use	NRHP Recommendation
T5655	Ethylene Generator Building	Not Eligible
5689	Gasoline Pump House	Not Eligible
5690	Gas Loading Station	Not Eligible
5691	Bulk Storage Tank	Not Eligible
5692	Bulk Storage Tank	Not Eligible
5693	Bulk Storage Tank	Not Eligible
5694	Bulk Storage Tank	Not Eligible
5695	Bulk Storage Tank	Not Eligible
5696	Bulk Storage Tank	Not Eligible
5697	Bulk Storage Tank	Not Eligible
5698	Bulk Storage Tank	Not Eligible
5699	Bulk Storage Tank	Not Eligible

The storage of bulk alcohol, gas, and oil was vital to the operation of Huntsville Arsenal. Large bulk tank farms were located in both Plant Area 1 and Plant Area 2. All of these bulk tanks appear on the architect's building schedule for completion in 1943.

The tanks are typical of industrial structures. They rest on a series of concrete semi-circular "cradles" and have ladders leading from the ground to the top of the tanks. They are still in use by the Redstone Arsenal and are in no danger of demolition or neglect. Today they are surrounded by plastic "moats" in case of spills. It can be assumed the moats of today are in compliance with Federal environmental laws and did not exist during WWII.

Support Buildings 5690 and 5689 are standard construction tile gabled buildings that served at various times as pumping stations and actual gas stations to support the automotive fleet at Huntsville Arsenal.

In previous reports, Building T5655 (ethylene generator building) was discussed as a miscellaneous building in Plant Area 2. It was moved to this section because it is located immediately adjacent to the tank farm and has a similar function to the other storage structures in this area. Ethylene was a chemical used in the production of several toxic gases including mustard gas.

Millions of gallons of alcohol were used at Huntsville Arsenal for the manufacturing of mustard gas and Lewisite. It sometimes served as an active ingredient and other times as a reactor coolant. Alcohol was stored in bulk tanks as well as underground tanks located in the plant areas themselves. The storage of pure grain alcohol in a “dry” county made for constant problems. A number of ingenious methods were devised for siphoning of the alcohol into coke bottles, which, in turn, found their way to parties and late night meetings (Stephens 1984:109).

**Recommendation:** These tanks are not unique and hold no particular historic value. They are not recommended as eligible to the NRHP under the World War II context.

**ALSHPO Comments:** The ALSHPO concurred with this recommendation per letter dated May 18, 2001 to the Redstone Arsenal’s Directorate of Environmental Management.

### Plant Area 3

Plant Area 3 was used for the manufacturing and filling of smoke munitions and incendiary weapons. It is different from the other two plant areas in that no chemicals were actually manufactured here. The ingredients making up smoke munitions and incendiary weapons were instead procured from outside sources and were mixed and assembled into shells at the plant. The structures are concrete and hollow clay tile and are spread out over many acres because of the explosive nature of the munitions produced.

Historic maps show that the plant was divided into three primary areas—smoke munitions filling (SMF), incendiary bombs (IB), and grenade filling (GF) (Figure 15). The exact delineation, however, is difficult to discern. The incendiary area was frequently used for smoke munitions production and vice versa. The entire plant is often simply referred to as the smoke and incendiary area in other historic documents and may have actually functioned as a large single plant. Production of one type of munition could also take place in different areas. Parts of the M2, 105 mm colored smoke canister, for example, were created at the Huntsville Arsenal from May 1943 to July 1945. The smoke charge was prepared in buildings 3645, 3646, and 3647. The starter mix was prepared in building 3473; the sleeve impregnated in building 3475; and in fill and press building 3788, all the components were assembled and marked. These structures were located in all three areas. The building uses also varied according to production quotas (*History of the Huntsville Arsenal* n.d.:516-518).

### Huntsville Arsenal—Plant Area 3: Smoke Munitions Filling Plant 1 (or SMF Area)

Table 12. Huntsville Arsenal—Plant Area 3: Smoke Munitions Filling Plant 1

Building Number	WWII Use	NRHP Recommendation
3421	Office Building	Not Eligible
3463	Magazine and Paint Storage	Not Eligible

3465	Box Making Building	Not Eligible
3470	Paint, Mark, and Box Building	Not Eligible
3471	M1 Smoke Pot Painting, Packing and Assembly Building	Not Eligible
3474	Starter Mix Building	Not Eligible
3476	Small Magazine	Not Eligible
3478	Sleeve Impregnating Building	Not Eligible
3479	Sleeve Impregnating Building	Not Eligible
3483	Fill and Press Building	Not Eligible
3490	Mixing and Blending Building, DEMOLISHED 1998	Not Eligible
3491	Mixing and Blending Building	Not Eligible
3492	Mixing and Blending Building	Not Eligible

This particular production line did not assemble a specific munition. Quotas for various munitions fluctuated constantly, therefore, the production lines were often modified. Smoke munitions created in these buildings include the HC M1 smoke pot, colored smoke canisters and smoke shells. Some buildings were used for a variety of ammunitions over the course of the war. In Building 3479, for example, employees made 105 mm smoke canisters, smoke pots, M88 smoke shells, and M3 and M4 155 mm colored smoke canisters. Buildings 3478 and 3479 were used in the clothing renovation project.

Many of the production lines had painting and box making buildings, such as Buildings 3463, 3465, and 3470, within their confines since the munition was filled, crimped, and boxed for shipping at that site. In some cases, the paint shops actually made the paint or varnish used to mark the boxes and munitions. Since munitions were prepared for shipping, storage magazines such as Building 3476 were required.

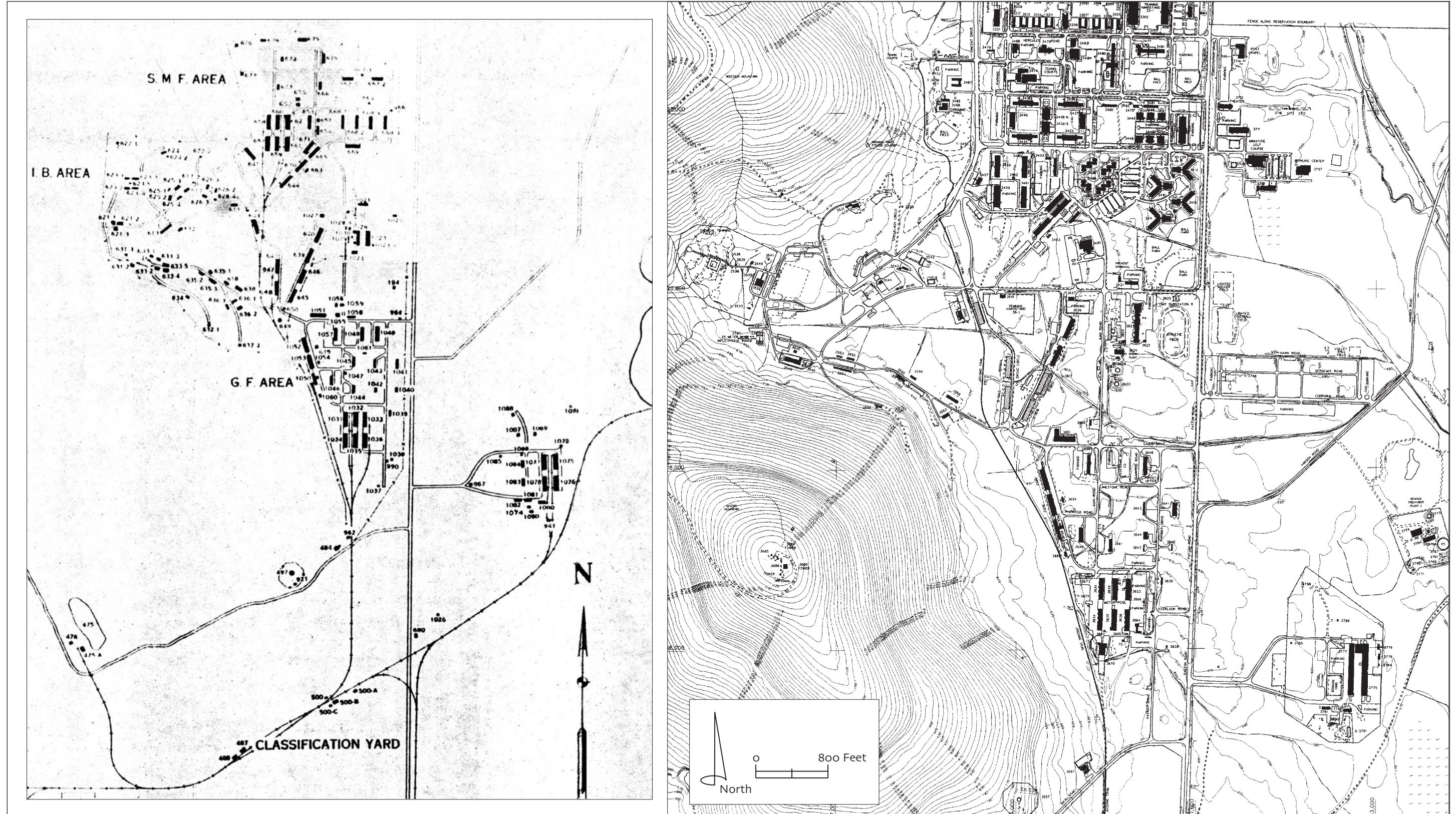
Most manufacturing buildings had simple, large, open floor plans that enabled them to be readily adapted to the making of new materiel. Although mixing and blending structures like Buildings 3474, 3490, 3491, and 3492 had specialized equipment, they could be recalibrated with very little loss of work time. Even the fill and press buildings, like Building 3483, could be adjusted as needed. As a consequence, these buildings were easily adapted after WWII to a number of uses from barracks to classrooms to gymnasiums. During WWII, many of these line buildings were connected to each other by covered ramps, like those in the Redstone Arsenal, but none of the ramps are extant (Nolte 1998:56-57, *History of the Huntsville Arsenal* n.d.).

**Recommendation:** Although all of the necessary building components of smoke munitions production are represented here, many of the buildings (3421, 3465, 3470, 3474, 3479, 3483, and 3491) have new modern metal siding which jeopardizes their integrity. The unaltered buildings (3471, 3476, 3478, and 3492) were used as storage and manufacturing structures. This group of buildings is not considered eligible to the NRHP under the World War II context because the majority of buildings lack integrity. Also the historic setting of the buildings has been compromised by the addition of numerous, non-historic structures that were constructed during later area expansions.

**ALSHPO Comments:** The ALSHPO concurred with this recommendation per letter dated May 18, 2001 to the Redstone Arsenal's Directorate of Environmental



Figure 15  
Historic and Modern Maps of Huntsville Arsenal, Plant Area 3





Management. The ALSHPO concurred that Building 3490 was not eligible in a February 20, 1998 letter and subsequently demolished.

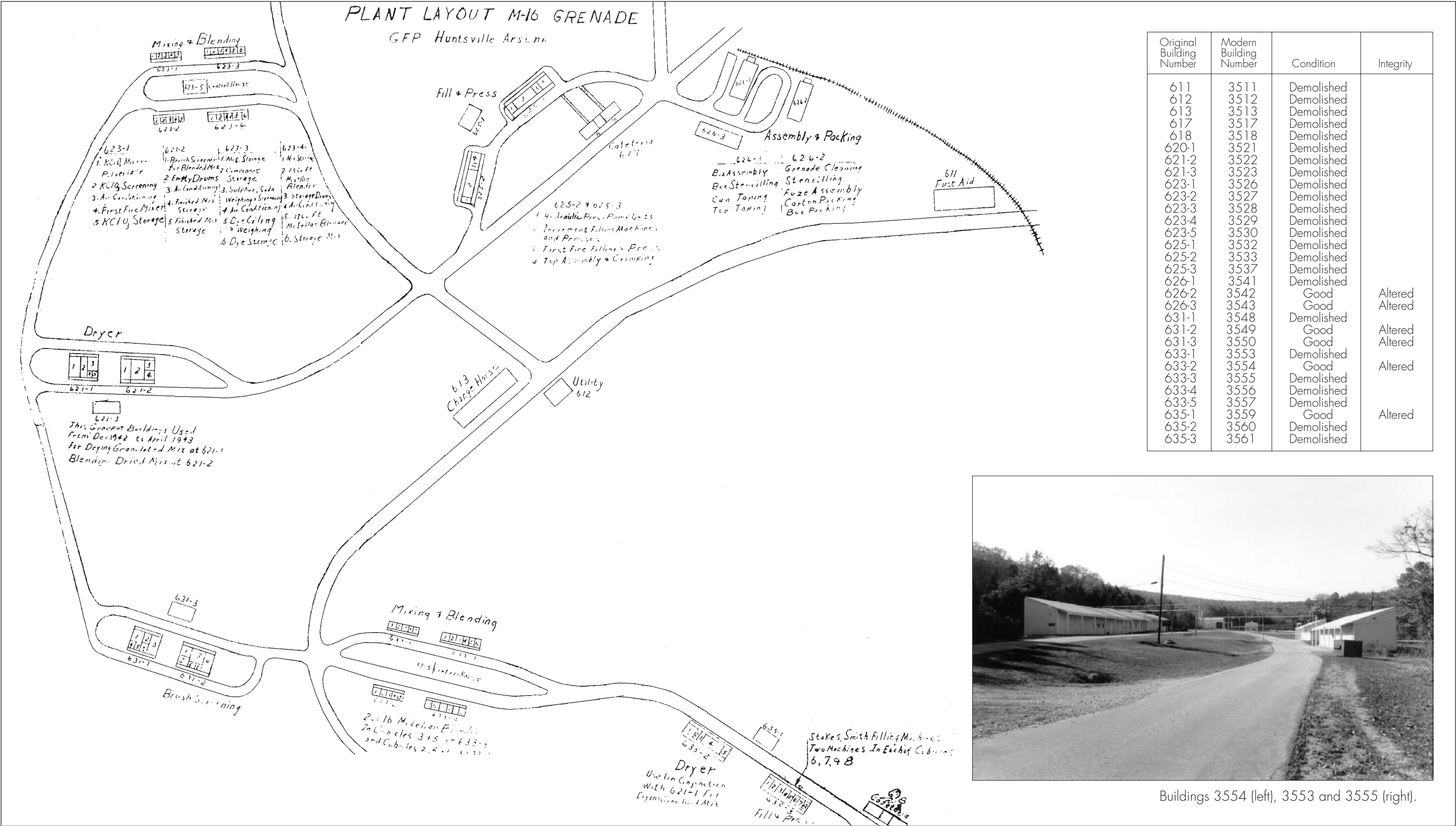
### Huntsville Arsenal—Plant Area 3: Incendiary Bomb (IB) Plant

Table 13. Huntsville Arsenal—Plant Area 3: Incendiary Bomb (IB) Plant

Building Number	WWII Use	NRHP Recommendation
3444	Inert Storage Warehouse	Not Eligible
3453	M-8 Mixing Building	Not Eligible
3524	Small Magazine	Not Eligible
3525	Small Magazine	Not Eligible
3531	First Fire Mix Building	Not Eligible
3542	Assembly and Pack Building	Not Eligible
3543	Assembly and Pack Change Building	Not Eligible
3549	Main Screening and Proportioning Building	Not Eligible
3550	Change House for Screening and Proportioning Building	Not Eligible
3551	Small Magazine, DEMOLISHED 1998	Not Eligible
3553	Mixing Building, DEMOLISHED 2000	Not Eligible
3554	Dry Starter Building	Not Eligible
3555	Mixing Building, DEMOLISHED 2000	Not Eligible
3557	Change House, DEMOLISHED 1998	Not Eligible
S3559	Change House for Fill and Press	Not Eligible
3560	Starter Cup Filling and Drying Building, DEMOLISHED 2000	Not Eligible
3563	Assembly and Pack Building, DEMOLISHED 2000	Not Eligible
3564	Assembly and Pack Building, DEMOLISHED 1997	Not Eligible
3565	Assembly and Pack Change House, DEMOLISHED 1998	Not Eligible
3568	Smoke Pot Fill and Press, DEMOLISHED 2000	Not Eligible
3613	IB Warehouse	Not Eligible
3614	IB Warehouse	Not Eligible
S3615	Warehouse	Not Eligible
3616	IB Warehouse	Not Eligible
S3617	IB Warehouse	Not Eligible
3618	Warehouse	Not Eligible
3619	Warehouse	Not Eligible

Although this is labeled the IB or incendiary bomb area, on historic maps (see Figure 15), the Huntsville Arsenal history also calls this section the GFP area—probably meaning the grenade filling plant. Originally it was designed and used for M14 incendiary grenades, but in October-November 1942 when an order for 30,000 M16 colored smoke grenades was issued, the buildings were modified to meet this demand. As M16 production grew, it took over the entire thirty-acre GFP area until it was superseded by the M18 grenade (*History of the Huntsville Arsenal* n.d.: 664) (Figure 16). As Figure 16 suggests, most of these buildings have since been demolished. Since the Huntsville Arsenal was the primary producer of colored smoke munitions, more space

Figure 16  
Huntsville Arsenal M-16 Grenade Layout





was needed for their manufacture and the incendiary area was most likely the most logical source of additional production line buildings.

The incendiary agents produced in this area probably only included the grenades as the bombs were manufactured in building 5681 in chemical Plant Area 2. The M14 grenade was produced in some of the above M16 colored smoke buildings from August to December 1943 and then incendiary grenade production ceased completely at the Huntsville Arsenal. Figure 17 shows that many of the incendiary grenade buildings have since been destroyed.

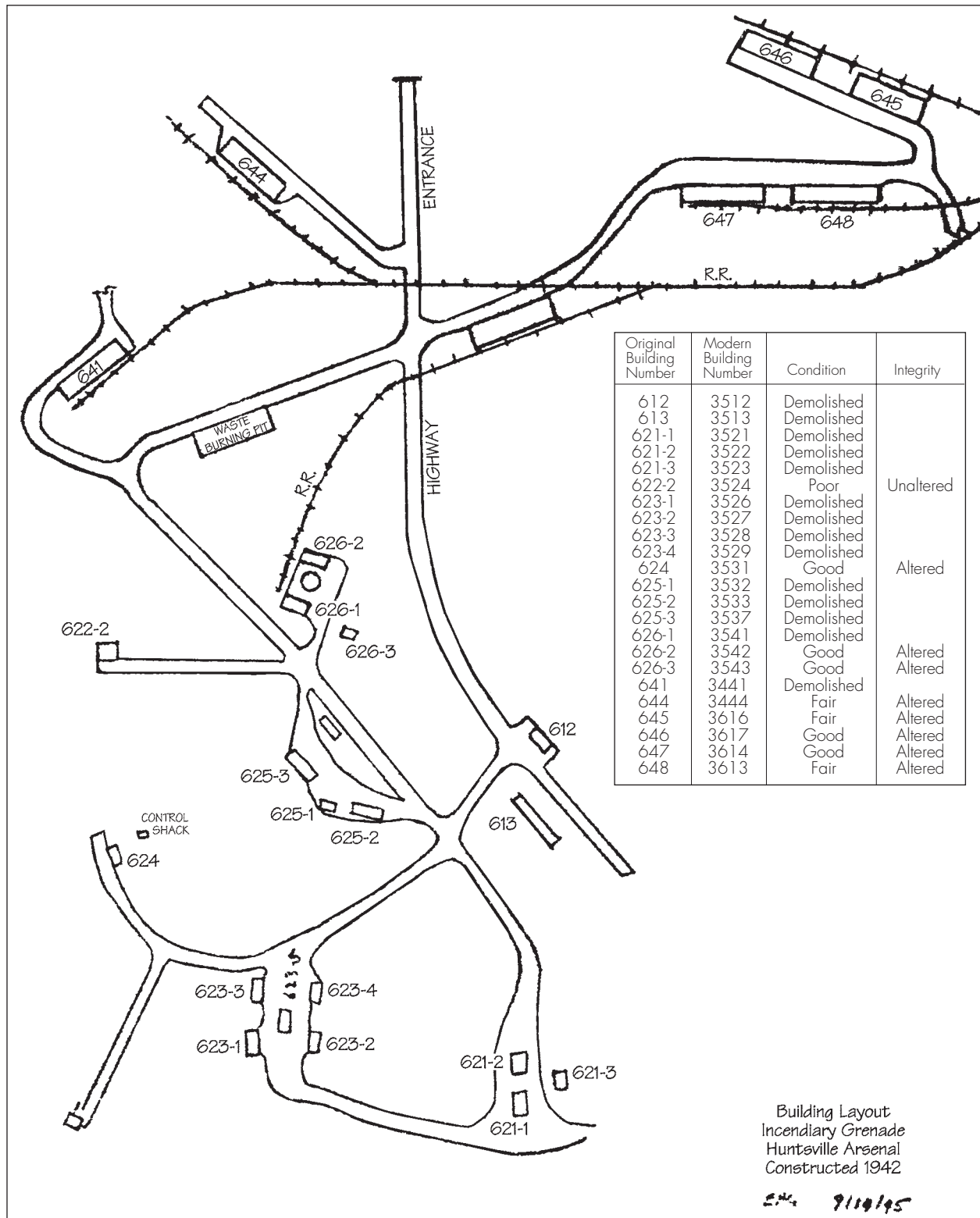
Other smoke munitions were manufactured in these buildings include the ANM-3 grenade and the M22 rifle grenade. In building 3568 the M4 floating smoke pot was manufactured for the first time at the Huntsville Arsenal (Joiner 1966). M8's (colored smoke hand grenades) were produced within several of these buildings (3453, 3463, 3553, and 3563) intermittently from September 1942 to March 1945 (Baker and Hughes 1993:16). Colored smoke canisters were also manufactured here in Buildings 3553 and 3555. Portions of lines are clear and involve the use of standard structures, such as change houses, mixing and blending buildings, assembly and packing buildings, fill and press buildings, magazines, and warehouses. A rail line connects the assembly and packing structures for easy transportation. None of these buildings are unique, having all been constructed of traditional WWII materials using standard industrial plans of the period.

**Recommendation:** As so many of the original production line buildings have been either destroyed or altered with new siding (3531, 3542, 3543, 3549, 3550, 3554, 3559, 3613, 3614, and 3619), the eligibility of this manufacturing group is questionable. The unaltered buildings (3444, 3524, 3525, 3615, 3616, 3617, and 3618) are primarily storage facilities and do not represent a complete production line. Several buildings (3551, 3553, 3555, 3557, 3560, 3563, 3564, 3565, and 3568) were determined not eligible to the NRHP under the WWII context by the ALSHPO and have since been demolished.

Given the loss of major buildings in this area and the lack of integrity of those that are extant, none of these buildings are recommended as eligible to the NRHP under the WWII context.

**ALSHPO Comments:** Buildings 3551, 3557, 3564, 3565, 3615, and 3619 were determined to be not eligible to the NRHP under the WWII context and the ALSHPO concurred by letter dated February 20, 1998. Four of these structures have since been demolished. The ALSHPO also agreed that Buildings 3553, 3555, 3560, 3563, and 3568 were not eligible to the NRHP under the WWII context per letter dated August 15, 2000 and they have been demolished. The ALSHPO concurred with the above recommendation through a letter dated May 18, 2001 and agreed that remaining Buildings 3444, 3453, 3524, 3525, 3531, 3542, 3543, 3549, 3550, 3554, 3559, 3613, 3614, 3616, 3617, and 3618 are also not eligible to the NRHP under the WWII context.

Figure 17  
Huntsville Arsenal Incendiary Grenade Layout Map



### Huntsville Arsenal—Plant Area 3: Miscellaneous Buildings

Table 14. Huntsville Arsenal—Plant Area 3: Miscellaneous Buildings

Building Number	WWII Use	NRHP Recommendation
3622	Oil Storage and Dispensing Building	Not Eligible
3623	Machine Shop	Not Eligible
3624	Boiler House	Not Eligible
3627	Fire Station and Weather Station	Not Eligible
S3629	Air Compressor Building	Not Eligible
3654	Magazine	Not Eligible
T3655	Office Building	Not Eligible
3656	Garage and Tool Room, DEMOLISHED 2000	Not Eligible
3657	Change House, DEMOLISHED 2000	Not Eligible

Like the miscellaneous structures in the chemical plant areas, these buildings primarily served as infrastructure, storage, and administration buildings and not as manufacturing facilities (Building 3657 probably served as a change house for the smoke munitions plant 2, but will remain here for the purposes of this report.). They are typical of other WWII structures on the post. Many have been altered with new metal siding (3623, 3627, and 3629) and Building 3655 has been moved from its original location making it ineligible to the NRHP. The unaltered buildings (3622, 3624, and 3654) are not historically significant and served as storage buildings and a boiler house. Although Building 3624 is the largest and most impressive boiler house being several stories high and constructed of concrete and clay tile with a separate clay tile tank adjacent to the south elevation, it still holds no historical value. The buildings probably served the entire plant facility and cannot be related to any one munition production.

**Recommendation:** Given the above, the miscellaneous buildings of Plant Area 3 are not considered eligible to the NRHP under the World War II context.

**ALSHPO Comments:** Through a letter of concurrence dated May 18, 2001, the ALSHPO agreed that buildings 3622, 3623, 3624, 3627, S3629, and 3654 are not eligible to the NRHP under the WWII context. The ALSHPO agreed that Buildings 3656 and 3657 were not eligible to the NRHP under the WWII context per letters dated December 8, 1999 and August 15, 2000 respectively and were demolished in 2000.

### Huntsville Arsenal—Plant Area 3: Smoke Munitions Filling Plant 2

Table 15. Huntsville Arsenal—Plant Area 3: Smoke Munitions Filling Plant 2

Building Number	WWII Use	NRHP Recommendation
3631	Motor Repair Building	Not Eligible
3632	Warehouse	Not Eligible

3633	Warehouse	Not Eligible
3634	Warehouse	Not Eligible
3635	Warehouse	Not Eligible
3636	Warehouse	Not Eligible
3637	Small Powder Magazine, DEMOLISHED 1995	Not Eligible
3638	Small Powder Magazine	Not Eligible
3639	Gas Station	Not Eligible
3640	Starter Mix Building, DEMOLISHED 2000	Not Eligible
3641	Sleeve Impregnating Building	Not Eligible
3642	Starter Mix Building, DEMOLISHED 2000	Not Eligible
3643	Change House for Assembly and Pack Building, DEMOLISHED 2000	Not Eligible
3647	Mix and Blend Control House, DEMOLISHED 1995	Not Eligible
3648	Fill and Press Building	Not Eligible
3649	Fill and Press Building, DEMOLISHED 1998	Not Eligible
3650	Fill and Press Building (now connected to 3652 and 3653, DEMOLISHED 2000)	Not Eligible
3651	Process Warehouse	Not Eligible
3652	Warehouse (now connected to 3650 and 3653)	Not Eligible
3653	Painting, Packing and Assembly Building (now connected to 3650 and 3652)	Not Eligible
3660	Starter Mix Building, DEMOLISHED 1999	Not Eligible
3664	Motor Maintenance Building	Not Eligible

This area is listed as the GF area on historic maps (possibly meaning grenade filling). Although less information is available on these particular structures, records do show that workers assembled smoke pots in buildings 3648, 3649, and 3650. This is also the site of a concentration of warehouses—a building type not as visible in other sections of Plant Area 3. Other chemicals such as H and HC may have also been loaded here.

Portions of lines are clear and involve the use of standard structures, such as change houses, mixing and blending buildings, assembly and packing buildings, fill and press buildings, magazines, and warehouses. A rail line connects the assembly and packing structures for easy transportation. None of these buildings are unique, architecturally or historically, having all been constructed of traditional WWII materials using industrial plans of the period.

Building 3648, the fill and press building, was typical of its type. Blueprints show that these types of buildings were very long, low, side-gabled structures built of construction tiles on concrete footings (Figure 18). The buildings had a second story that extended across about a third of the actual length of the building. Fill areas were divided from each other by a concrete fire/blast wall as a safety precaution.

Unlike the other sections of the smoke munitions Plant Area 3, a large number of these structures remain unaltered (3632, 3634, 3635, 3636, 3638, 3639, 3641, 3652, 3653). The others (3631, 3633, 3648, 3651, and 3664) have either new metal siding or large additions. Building 3649, a large smoke munitions fill and press structure crucial to the production process, was demolished in 1998. Despite this loss, it appears that few structures have been lost when comparing the current landscape to historic maps. This SMF area is certainly the most compact and least changed. The buildings are close together with few modern intrusions and could constitute a district, but half are storage

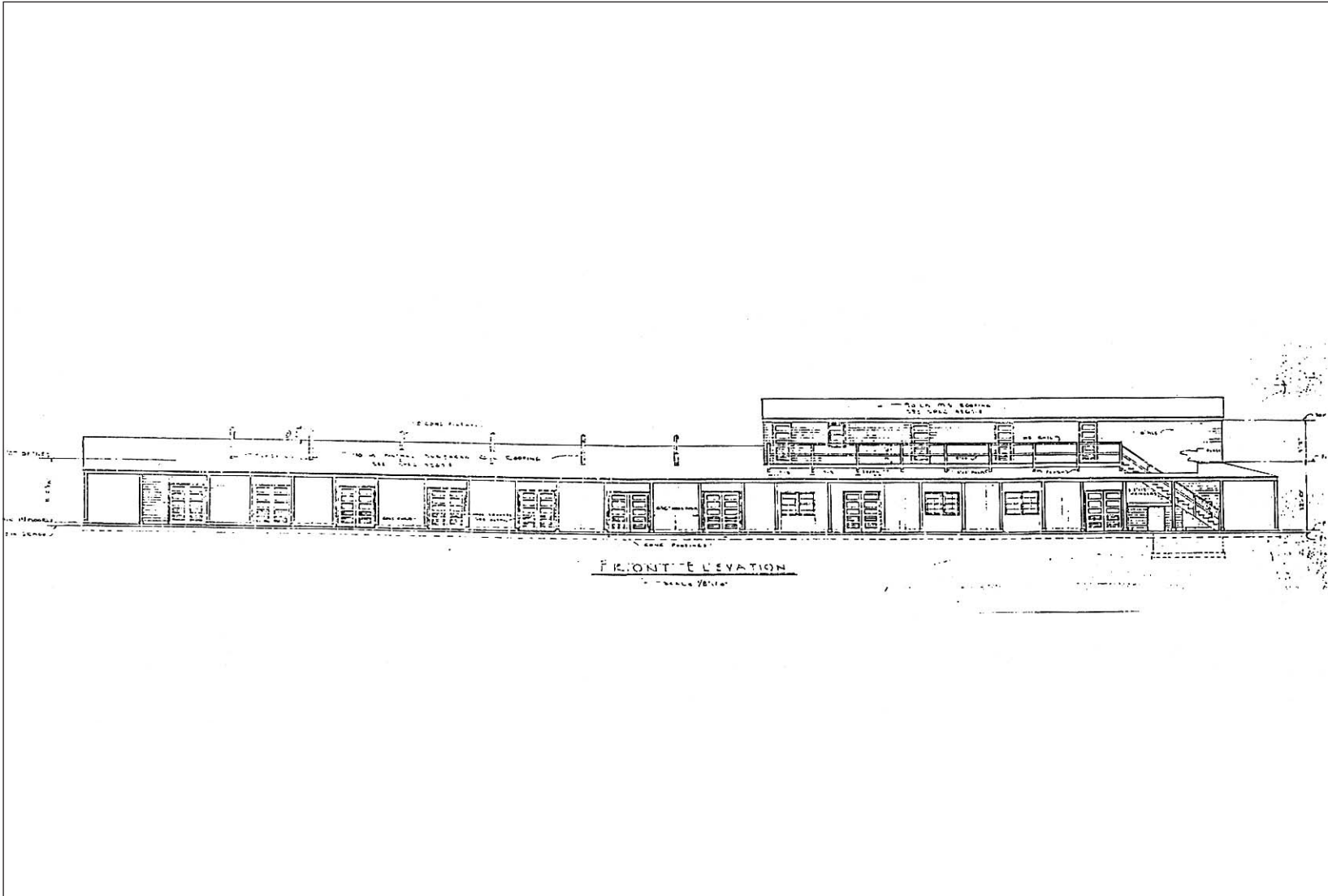


Figure 18  
Blueprint of Building 3648

buildings and not involved in the actual production of smoke munitions. Some of the pivotal buildings in this section like 3648, 3649, and 3650 which were smoke pot buildings—one of the most important and extensively manufactured products at the Huntsville Arsenal—have been severely altered or demolished. Many of the other production line buildings have also been changed.

**Recommendation:** Given the loss of integrity in the buildings and the absence of several key structures that were pivotal to the manufacturing process, the extant resources in the smoke munitions filling plant 2 do not constitute a NRHP district and are not recommended as eligible to the NRHP under the World War II context.

**ALSHPO Comments:** Through a letter of concurrence dated May 18, 2001, the ALSHPO agreed that Buildings 3631, 3632, 3633, 3634, 3635, 3636, 3638, 3639, 3641, 3648, 3651, and 3664 are not eligible to the NRHP under the WWII context. Building 3649 was determined to be ineligible to the NRHP by letter of concurrence from the ALSHPO dated February 20, 1998. It has since been demolished. The ALSHPO concurred that Buildings 3650, 3652, 3653, and 3660 were not eligible to the NRHP under the WWII context per letter dated December 8, 1999. Buildings 3650 and 3660 were demolished later that year. The same recommendation was made for Buildings 3640, 3642, and 3643 per letter dated August 15, 2000 and they are also no longer standing. Buildings 3637 and 3647 were demolished in 1995 under an MOA among RSA, ALSHPO and the Advisory Council on Historic Preservation dated May 22, 1996.

### Huntsville Arsenal—Plant Area 3: Chloroacetophenone-Adamsite (CN-DM) Plant

Table 16. Huntsville Arsenal—Plant Area 3: Chloroacetophenone-Adamsite (CN-DM) Plant

Building Number	WWII Use	NRHP Recommendation
3775	Warehouse	Not Eligible
3776	Paint and Spray House	Not Eligible
3777	Warehouse	Not Eligible
3779	Magazine	Not Eligible
3780	Assembly and Pack Building, DEMOLISHED 1999	Not Eligible
T3781	Office and Change House	Not Eligible
3784	Mix Building	Not Eligible
3785	Magazine, DEMOLISHED 1999	Not Eligible
3788	Magazine, DEMOLISHED 1999	Not Eligible
3789	Magazine	Not Eligible
3790	Magazine	Not Eligible

Tear gas munitions were produced at the Huntsville Arsenal beginning in December 1943 and continuing through May 1944. Tear gas was a harassing agent known as chloroacetophenone (CN) which did not completely disable troops, but did require them to wear bulky, uncomfortable gas masks for extended periods of time (Joiner 1966:36). The chemical itself was procured from the Edgewood Arsenal, the

Pennsylvania Salt Company, and the Lake Erie Chemical Company, but the munitions were filled and packaged at Huntsville (*History of the Huntsville Arsenal* n.d.:596). Among the munitions manufactured at the Huntsville Arsenal were the M-6 and M-7 grenades and the M-20 and the M-22 rifle grenades. The Huntsville Arsenal manufactured 243,020 M-7s from December 1943 through April 1944 while the other producer, the Edgewood Arsenal, made 446,590 M-7 grenades during World War II (Joiner 1966:36). The M-6 grenades were combined with a vomiting agent known as Adamsite (DM) which acted rapidly and also caused chest pain, sneezing, coughing, and headaches (Nolte 1998:62). Huntsville produced these for only one month in April and May of 1944, but they manufactured a total of 252,348—nearly 43% of all made during World War II (Joiner 1966:36, Brophy et al. 1988:72). Despite its non-lethal nature, tear gas, like the other toxic gases, was not employed during battle in World War II.

The CN-DM area is separated from the remainder of the Huntsville Arsenal production buildings and is located on the east side of Patton Road. Originally, the plant was arranged in a compact, rectangular shape with warehouses and storage facilities flanking its east side. Today the layout is much the same with few modern intrusions.

During WWII, four large warehouses existed, but now only two remain (3775 and 3777) along with a smaller one (Building 3779); all three are typical of the period. The two largest warehouses feature a concrete fire wall rising above the roofline about one-eighth of the way from one end of the building suggesting that explosives were stored in these buildings. Aside from this unusual firewall, the warehouses are standard length and width (80 feet x 52 feet 4 inches), made of construction tiles, and have side-gabled roofs like others on post. The smaller storage buildings (3785, 3788, and 3789) are also standard WWII military structures with construction tile walls and flat roofs.

Like the other plant areas, the CN-DM plant had its own administration buildings, including offices, change house, and maintenance shops. These structures are comprised of standard WWII construction materials and set in typical building configurations found all over Redstone Arsenal. A blueprint for the change house, Building 3781, shows that it was a side-gabled, frame structure containing locker rooms, showers, toilets, clothing distribution and collections rooms. Like others on the post, the change house is divided into three changing areas: the white men's, white women's, and colored men's.

Nearly all of the production buildings have been altered with new siding or additions (3775, 3776, 3777, 3779, and 3781). The unaltered buildings (3784, 3789, and 3790) are primarily storage magazines.

**Recommendation:** The production buildings' lack of integrity compromises their eligibility to the NRHP. Also, tear gas was never used in combat during World War II rendering its importance as a weapon negligible and lessening the significance of resources associated with its manufacture. Unlike the other toxic gases, the chemicals used to manufacture tear gas and Adamsite were not manufactured at the Huntsville Arsenal. These chemicals were instead procured from outside sources and then loaded

into grenades at this site. Furthermore, this plant only operated for six months during WWII. Given these factors, the structures in the former CN-DM facility are recommended as not eligible to the NRHP under the World War II context.

**ALSHPO Comments:** Through a letter of concurrence dated May 18, 2001, the ALSHPO agreed that Buildings 3775, 3776, 3777, 3779, T3781, 3784, 3789, and 3790 are not eligible to the NRHP. The ALSHPO concurred that Buildings 3780, 3785, and 3788 were not eligible to the NRHP per letter dated December 8, 1999 and were demolished later that year.

### Huntsville Arsenal Miscellaneous Buildings

Table 17. Huntsville Arsenal Miscellaneous Buildings

Building Number	WWII Use	NRHP Recommendation
3197	Maintenance Shop	Not Eligible
3236	Telephone Switch House	Not Eligible
3796	Primary Substation 2	Not Eligible
T5285	Unknown, DEMOLISHED 1996	Not Eligible

Four WWII buildings on Huntsville Arsenal do not fall within any special use category. They are either infrastructure or maintenance buildings with no association with the production lines of the Huntsville Arsenal. Building 3197 is a maintenance shop with new metal siding. It is located on the eastern side of the Arsenal near Gate 8. Building 3236 is unaltered with a flat roof and tile construction and is located just across from Building 3197, but holds no historical value or architectural significance. Building 3796 is also a small, flat roof, unaltered structure located on the eastern side of Patton Road south of plant area 3 on an isolated dirt road. It also holds no historical value or architectural significance. Building T5285 was demolished in 1996.

**Recommendation:** Because of alterations and lack of historical and architectural importance, it is recommended that none of the miscellaneous Huntsville Arsenal buildings be considered eligible to the NRHP under the World War II context.

**ALSHPO Comments:** The ALSHPO concurred with this recommendation per letter dated May 18, 2001 to the Redstone Arsenal's Directorate of Environmental Management.

### Huntsville Arsenal—The Goddard House

Table 18. Huntsville Arsenal—The Goddard House

Building Number	Historic Name	NRHP Recommendation
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7134

Goddard House

Not Eligible

The Goddard House (Building 7134) is one of only two remaining pre-Army structures still standing on Redstone Arsenal (Figure 19). Although the house is presently located in the former administrative area of the Redstone Arsenal, it was actually moved to its current site in 1956 and “renovated” as a VIP guest house. It originally was located just west of present Gate 9 (the northern end of Rideout Road), a site considered too remote for continued Army use.

The house was probably built c. 1835 by James Manning, a wealthy merchant and planter, who owned 2,200 acres of land in Madison County partially on what is now the Redstone Arsenal, although it is not known if Manning lived in the structure. This house is considered to be one of the oldest structures in the county. The land now comprising Redstone Arsenal contained some of the richest agricultural land in the county. Typical crops produced included cotton, corn, hay, peanuts, and various fruits and vegetables, and some farmers in the area raised livestock (Hughes 1992). M. G. Chaney bought the house and land in 1924 and continued to farm. Unlike Manning, Chaney relied on tenant farmer labor and the home’s kitchen served as a commissary. According to Nellie McAnally, a former resident of the house whose father served as Chaney’s overseer, the structure was originally covered in clapboards and featured a small front porch and a larger screened back porch. A drive lined with cedar trees led to the front door. Each room in the house had its own fireplace serviced by massive chimneys. Originally, the first floor had large folding doors between the parlor and the dining room, decorative columns and a mirrored back wall creating an elegant entertainment area. The first floor was altered in the 1920s with the creation of a kitchen. The second floor was accessed by two sets of stairs: a large set in the front hall and a smaller one in the back. The attic could be reached by a third stairway located in the back of the upstairs hall. The original second story plan featured four rooms and two halls (Rogers 1989).

After the U. S. Army purchased it in 1941, the house was closed, but it was soon needed for barracks and the Army renovated it in 1942 for military families. This renovation apparently included covering the outside of the house with stucco. In 1953, it was closed again because of water problems and slated for demolition; however, the need for guest housing was so great that a new use was found for the structure.

In 1956, it was moved eleven miles to its current site and underwent extensive improvements and changes including the addition of pink marble mantles, an exterior veneer of yellow brick, a classical roof balustrade, and elegant new furnishings. Historic photographs show that the two-story portico is also an addition. The original porch was one story with a hip roof and extended across only the central bay. The windows have been drastically altered, particularly on the first floor where a large multi-pane, non-sash picture window has replaced a pair of double sash windows. The Army named the house in honor of Dr. Robert H. Goddard, this nation’s premier rocket scientist, but Goddard never lived in this house and in fact, died in August 1945 before the installation was granted its rocket affiliation (Nolte 1998:110).

Figure 19  
Photographs of the Goddard House



A. 1996 photograph of the Goddard House (Panamerican Consultants, Inc.).



B. 1996 photograph of the Goddard House, southeast corner from Redstone Road (Panamerican Consultants, Inc.).

A HABS/HAER Level III documentation was done on the Goddard House in 1983 concluding that it retained “little of its original integrity” and due to its many changes, possessed “little architectural or historical significance” (Building Technology, Inc. 1984).

Previous reports proposed that because this is the oldest structure on the Redstone Arsenal and retains the original framing members, it should be considered eligible to the NRHP under Criterion C and D. However, to be placed on the NRHP, a building must possess historic significance and integrity. According to the Secretary of the Interior’s guidelines, “historic integrity is the composite of location, design, setting, materials, workmanship, feeling and association” (National Park Service 1997:4). Although all seven qualities do not have to be present to gain recognition, the overall sense of past time and place must be evident. In the case of the Goddard House, its original details and construction materials have been drastically altered to the point that its overall historic fabric is gone.

The NRHP guidelines also state that “structures that have been moved from their original locations... shall not be considered eligible for the National Register” unless the moved building is part of a historic district. This is clearly not the case of the Goddard House. The buildings across the road serve as administration and testing facilities that have no association with the Goddard House and hold no historical or architectural value. The ALSHPO concurred that the officer housing behind this structure was not eligible to the NRHP. Furthermore, since the Goddard House was not in its present location during World War II, it cannot be related to them under a housing context either. A moved building may also be declared eligible if it is “primarily significant for architectural value, or which is the surviving structure most importantly associated with a historic person or event” (National Park Service 1997:7). Because of the described changes, the Goddard House has lost most, if not all, of its architectural value and it is not associated with a historically significant person or event. Finally, Criterion D is primarily used for archaeological properties. The Goddard House holds no important information related to housing during World War II.

**Recommendation:** It is recommended that this resource is not eligible to the NRHP under the World War II context.

**ALSHPO comments:** The ALSHPO concurred with this recommendation per letter dated May 18, 2001 to the Redstone Arsenal’s Directorate of Environmental Management.

## VII. REDSTONE ARSENAL

### REDSTONE ARSENAL HISTORICAL BACKGROUND

Named after the preponderance of red soil in the area, Redstone Ordnance Plant was established in September 1941 as the seventh of the Ordnance Corps manufacturing plants and the only one south of the Mason Dixon Line. The facility was upgraded, reorganized and renamed Redstone Arsenal in January 1943. The plant was located on 4,000 acres immediately adjacent to Huntsville Arsenal and was responsible for assembling chemical ammunition (Baker and Hughes 1993) (see Figures 20 and 21).

Aside from the convenience of a chemical plant near by, the location of Redstone Arsenal met the exacting criteria for the construction of an ordnance facility. The location was sufficiently removed from coastal areas and it lacked a large center of civilian population that might be endangered by the volatile nature of the production processes. Other considerations included the availability of water, manpower, electricity, railroads, and highways. Huge tracks of land were needed to provide substantial distances between production lines and storage spaces in case of an accidental explosion or an enemy attack. This distance also contributed to the remarkable safety record made by Redstone Arsenal in WWII (Thompson and Mayo 1991).

In September of 1941, Maj. Carroll D. Hudson (1899-1992) was named Commanding Officer of Redstone Ordnance Plant, and in this capacity, he also served as the Army Inspector of Ordnance. The choice of Maj. Hudson was propitious since his dedicated leadership at Redstone Arsenal led to the streamlining of numerous activities at the plant that were adopted at other ordnance facilities nationwide. Hudson was a WWI veteran and also held a mechanical engineering degree from Leland Stanford University. He served in the Civilian Conservation Corps from 1935-1938 and then in the Army Reserve until he was called into active duty in August 1940 and attended the Industrial College of the Armed Forces. He was then stationed at the Ammunition Division of the Office of the Chief of Ordnance until he became C.O. at the Redstone Ordnance Plant. He served at the Alabama post throughout WWII except for a two month break in the fall of 1943 when he was transferred to Office of Field Director of Ammunition Plants in St. Louis. Hudson "developed Redstone Arsenal into one of the best equipped and most productive munitions manufacturing centers in the U.S." During WWII, the facility earned five Army-Navy "E" Awards and produced nearly 80 percent of the Army's chemical ammunition without missing a quota. Hudson can be further commended for overseeing the monumental expansion and transition of the Redstone Arsenal into a center for rocket research and design when he became C.O. of the post in November 1948 (Redstone Arsenal website).



Figure 20  
Historic Redstone Arsenal Map

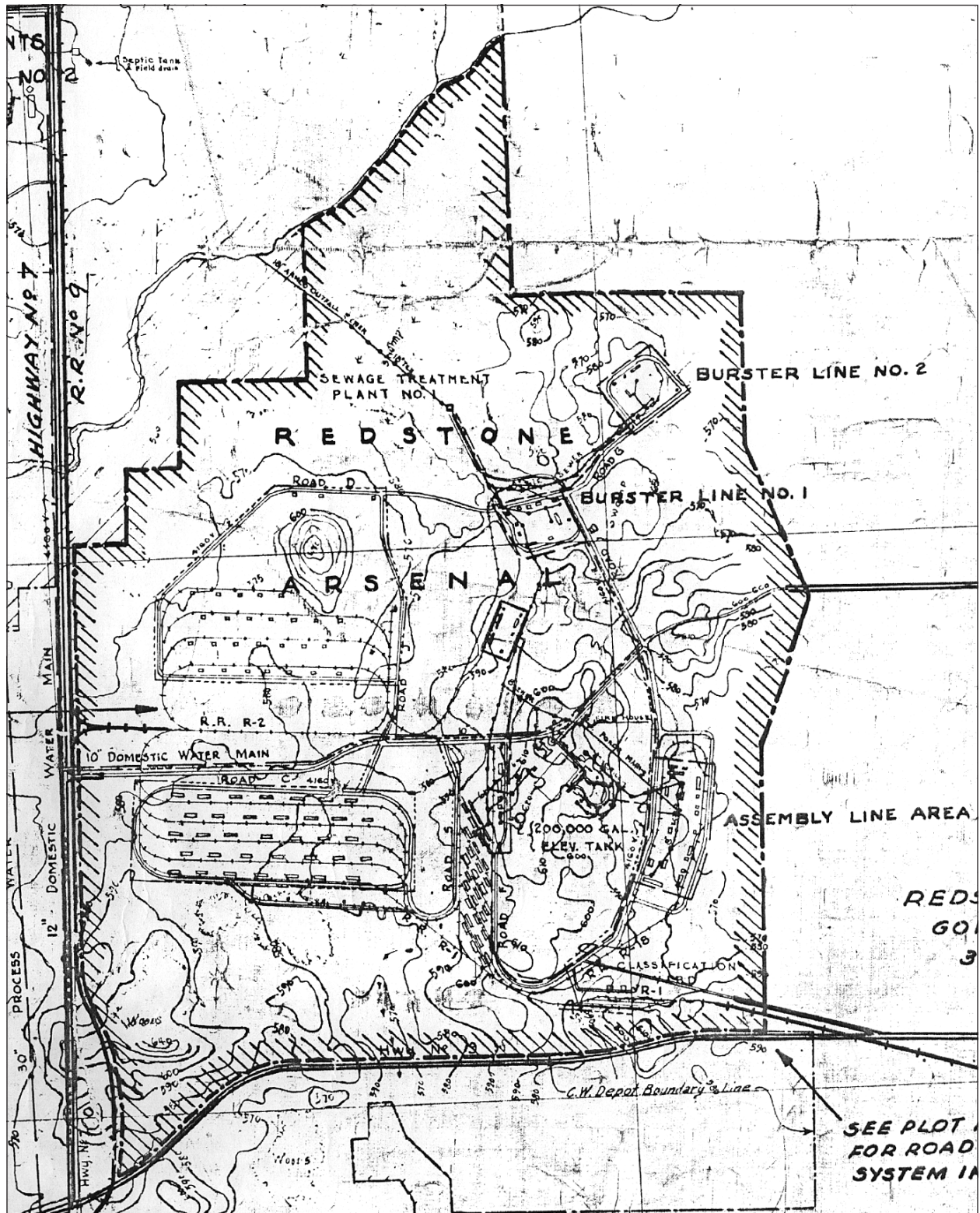
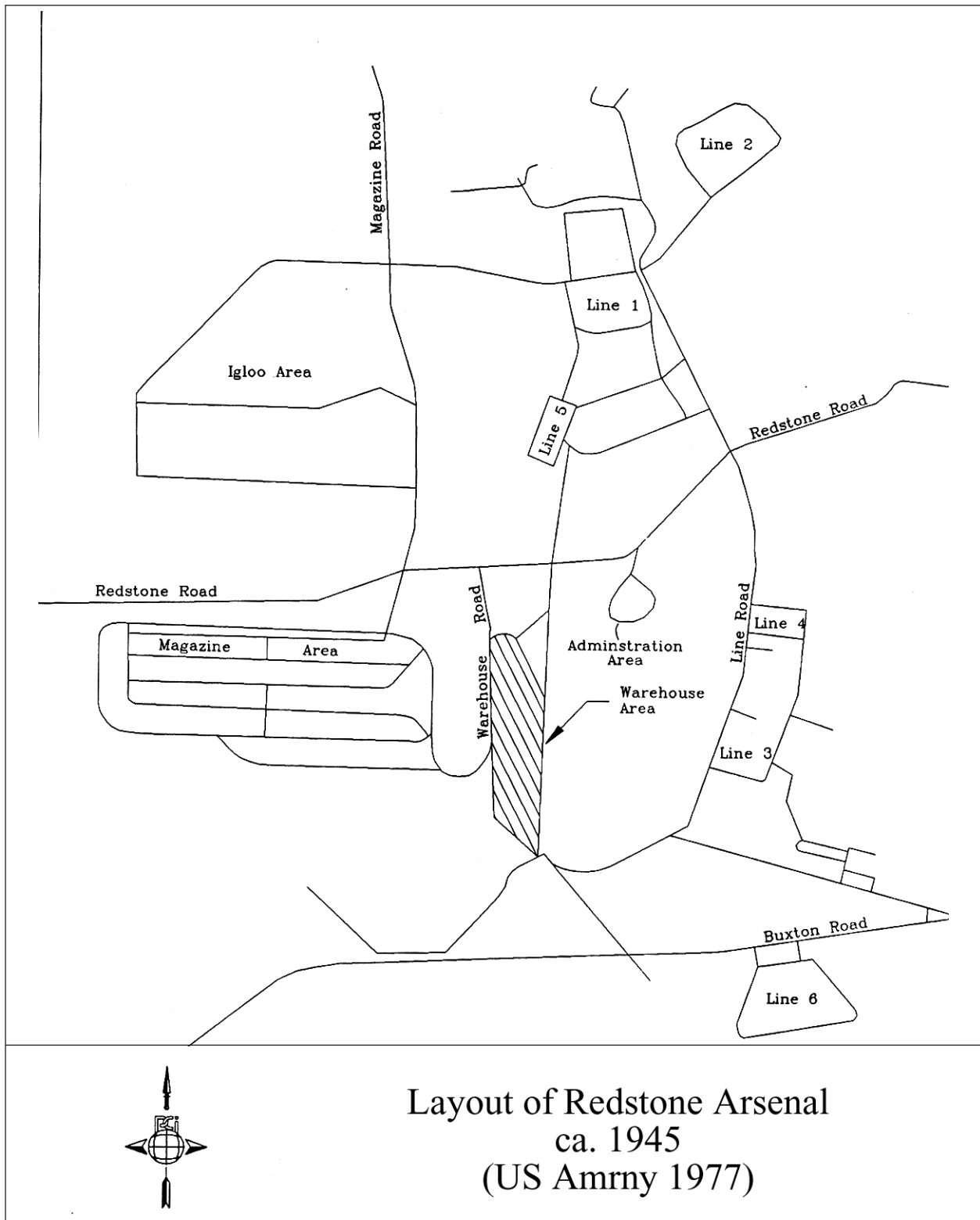


Figure 21  
Layout of Redstone Arsenal, c. 1945



Courtesy of Panamerican Consultants, Inc., 1998

On October 25, 1941, ground was broken for the Redstone Ordnance Plant, and the first building, the bachelor officers' quarters (Building A-131), now demolished, was completed November 11, 1941. After the Japanese attack on Pearl Harbor and the subsequent U.S. declaration of war, work on all three posts was placed on a 24-hour basis. Every effort was made to quickly complete the production lines, warehouses, igloos, magazines, shops, and fire and police buildings. On February 5, 1942, the War Department officially activated Redstone Ordnance Plant and the hiring rush began.

The original mission of Redstone was to assemble chemical ammunition from the 75-mm shell up to and including the 155-mm. They were also ordered to manufacture all bursters (the mechanism used to break open the shell itself) for chemical shells and bombs and assemble the 30 pound and 100 pound chemical bombs. The initial plans called for the construction of two loading and assembly lines for the 75-mm chemical shells as well as two lines for loading and assembling burster charges for those shells. Also to be built were inert storage warehouses, igloos, finished ammunition magazines, and utility and administration buildings. The burster No. 1 line was completed in 1941 and made M5 bursters. Lines 2, 3, and 4 were completed in March 1942, April 1942, and August 1942 respectively. The plant was expanded in 1943 with an additional line used to make 155-mm shells. Another line (Line 6) was constructed in 1945, but never put into production during World War II. Lines 1 and 2 both manufactured and loaded burster tubes. Lines 3 and 4 loaded and assembled chemical munitions (Joiner 1966).

The explosive ingredients for these bombs and shells were shipped from other arsenals to the Redstone plant. Other major components such as cases, fuses, boosters, and primers were also imported. The chemicals, however, were brought over directly from the Huntsville Arsenal. Typically, items received were inspected and tested at the ordnance plant and the empty shell and burster casings were then shipped over to the Huntsville Arsenal where they were filled with the corresponding chemical. At the Huntsville Arsenal, these shells were sealed by pressing the burster casing into its seat. The ammunition was then transported back to the Redstone Arsenal where it was inspected again and then assembled into a round of ammunition. A complete round consisting of the fusers and fillers, was then boxed, strapped, stenciled, and essentially made ready for shipment (Joiner 1966).

The ammunition manufactured at the Redstone Arsenal included the 105-mm M60 white phosphorus (WP) and mustard gas (H) shells; 155-mm WP or H shell; 100 pound A1 WP bomb; 100 pound A47A2 H bomb; 115 pound M70 H bombs; 75-mm M64 WP shells; 105-mm M84 smoke case ejection shells, and M4, M5, M6, M8, M10 burster charges. Burster charges were used in shells, bombs and grenades to disperse the smoke or gas on the target. They were long, narrow tubes filled with tetrytol, a high explosive more powerful than TNT. The technique of mass production of tetrytol was perfected at the Redstone Arsenal and a total of 14,233,000 bursters were produced here during the war (Cagle 1955:60).

In 1944 the facility began production of the 75-mm M89 base ejection shell; 155-mm M104 and M110 WP and H shells; 81-mm M57 WP mortar shell; the M13 burster; 105-mm M84 and 155-mm M116 propaganda shells; and colored smoke rifle grenades.

The plant also became the official center for screening and renovation of chemical ammunition that had been returned from overseas or to other depots in the U.S. Redstone Arsenal was extremely productive earning five Army-Navy "E" awards during the war. In January 1945 a huge expansion costing \$5.5 million began and included the construction of new buildings and the alteration of existing ones to improve productivity. In that year the plant was shipping twenty and sometimes fifty, carloads of ammunition per day as opposed to only two in 1942 (Joiner 1966 and Building Technology, Inc. 1984).

The Redstone Arsenal also made demolition blocks for the Corp of Engineers and Airborne troops beginning in 1943. These were used to demolish bridges, fortifications, and buildings to delay advancing armies. Demolition blocks were also employed by Navy underwater demolition teams to clear underwater obstacles and mines and break through coral reefs. These teams were used extensively ahead of assaults to clear beaches (Polmar and Allen 1994:827). Redstone produced and shipped 11,756,000 demolition blocks by the war's end (Cagle 1955:61).

After VJ Day, activity at Redstone Arsenal slowed rapidly, and production ceased on August 17, 1945. The lines were decontaminated and placed on standby. The renovation and salvage of wartime materiel continued until February 1947 when Redstone Arsenal itself was placed on standby status.

In October 1948 the Chief of Ordnance designated Redstone Arsenal as the center for ordnance rocket research and development. The installation was officially reactivated on June 1, 1949 as the site of the Ordnance Rocket Center. On June 30, 1949 Huntsville Arsenal ceased to exist as a separate installation and officially became the Chemical Division of Redstone Arsenal. The Secretary of the Army approved the transfer of the Ordnance Research and Development Division Sub-Office (Rocket) at Fort Bliss, Texas to Redstone Arsenal. The team, including Dr. Wernher von Braun, arrived in April 1950. Their arrival added the mission of research and development of guided missiles to the Arsenal's new mission. However, Redstone Arsenal also retained its WWII mission of producing chemical ammunition. In July 1951, following the U.S. entry into the Korean War, four ammunition lines on the installation were reactivated from standby status and resumed production. In the five years between July 1951 and July 1956, the arsenal produced over 38.7 million complete rounds of ammunition. By the end of 1955, the installation was producing a major portion of all chemical artillery ammunition used by the U.S. armed forces. The arsenal was not relieved of its mission to produce chemical ammunition until June 30, 1956 (Redstone Arsenal website [www.redstone.army.mil](http://www.redstone.army.mil)).

While the spectacular success in the more sophisticated field of missiles tends to overshadow its previous accomplishments, the Redstone Arsenal complex established a commendable record in WWII as one of the best equipped, most productive chemical munitions manufacturing centers in the nation. Over 45,250,000 units of ammunition were loaded and assembled for shipment between March 1942 and September 1945, and more than 27 million items of chemical munitions having a total value of over \$134.5 million were produced (Baker and Hughes 1993).



## REDSTONE ARSENAL LAYOUT AND REMAINING WWII RESOURCES

As the AMC historic facilities context shows, WWII production buildings can be broken into discrete areas based on their use (Cannan et al. 1996). Generally, these areas are administrative, storage (which can be divided into above-ground non-explosive storage and earthen bermed igloos for explosives), production areas (which include the lines), and small housing areas. All of these areas were typically connected by a road and railroad system. For the purposes of this report, the historic architecture remaining at the Redstone Arsenal has been divided into the same groups as the Huntsville Arsenal: manufacturing, housing, infrastructure, administration, maintenance, and storage. There is also a large number—almost thirty—buildings which have an unknown use, but were most likely related to the manufacturing buildings on the various lines. Since the initial survey was conducted in 1995-1996, seventy-six of the over 250 buildings or structures have been demolished.

As seen in Figure 21, the administrative area forms a loop off Redstone Road between the warehouse area and Lines 3 and 4. The administrative buildings include offices (7111, 7471, and 7605) and gatehouses (T7292, T7648, T7649, T7670, T7702, and T7862). The offices are associated both with the general administration of the plant and with individual production lines. The guardhouses are generally small, rectangular structures with many windows and clad with drop siding.

The eleven housing facilities consist primarily of a group of single family officer homes located in the administrative area. These are very similar in style and form to the Colonial Revival houses at the Huntsville Arsenal except they are smaller in size. There was also one barracks that has since been destroyed. The antebellum Goddard House (7134) which served as living quarters in its former location on the Huntsville Arsenal also stands adjacent to the Redstone Arsenal officer housing. This building was addressed in the Huntsville Arsenal section.

The storage facilities make up approximately 115 of the remaining historic structures at the Redstone Arsenal. Hudson was given permission to construct twenty-five inert storage warehouses, thirty-five finished ammunition magazines, and thirty igloos. The storage areas were serviced by a common road and rail system. There are twenty-nine igloos remaining measuring 40 feet, 60 feet or 80 feet long. They will be discussed in more detail below. The warehouses and magazines are similar in form and construction material, measuring 240 x 50 feet with gable roofs. All are constructed of hollow clay tile or brick. Because they were used to store non-explosive components, the twenty-nine remaining warehouses nearly adjoin one another and are located between the magazine area and plant lines 3 and 4. Housing explosive materials, the magazines are spread further apart and are located along Redstone Road away from other buildings. There is also a group of smaller, 43 x 28 foot fuse and primer storage buildings which are also made of tile located just to the south of the magazines.

The infrastructure buildings include boiler houses (7105, 7579, 7604, 7668, 7729, 8977), a laundry (7115), a generator station (7119), and a sewage lift station (7586). The boiler houses at the Redstone Arsenal are smaller than their counterparts at the Huntsville Arsenal and none match the massive scale of Building 3624. Three of the

boiler houses (7105, 7579 and 8977) are very similar with brick tile construction, flat roofs, and double, half-glass door entrances. The others are a mix of brick tile and balloon frame construction. They are generally larger buildings with gable roofs. The laundry (7115) is a brick tile structure with many double windows and a gable roof—a building clearly not related to the industrial processes of the other structures on this installation. The generator station (7119) is two stories in height with a gable roof making it very different in form and scale than those at the Huntsville Arsenal.

There are only four maintenance buildings (7103, 7104, 7107, and 7142) at the Redstone Arsenal and they served as repair shops (7103, 7104, and 7142) or gas stations (7107). The repair shops are basically warehouse-like structures with corrugated metal siding and no details. The gas station (7107), however, was perhaps one of the more interesting buildings at this installation having several additions giving it an odd shape. It was clad with drop siding with many windows. It has since been demolished.

The remainder of the buildings at the former Redstone Arsenal are related to the various manufacturing processes. They exist in a variety of forms depending on their original use. Many have been altered and large portions of those in Lines 1 and 2 have been demolished. The production lines form a narrow strip on the east side of the plant. They are numbered according to their construction completion. Traditionally, the lines have been referred to as South Plant, meaning Lines 3 and 4, because they are south of Redstone Road, and North Plant (Lines 1, 2, and 5) or those north of Redstone Road.

### Redstone Arsenal—North Plant: Line 1

Table 19. Redstone Arsenal—North Plant: Line 1

Building Number	WWII Use	NRHP Recommendation
7651	Service Magazine and Rest House, DEMOLISHED 1998	Not Eligible
7652	Tetryl Screening and Blending Building, DEMOLISHED 1998	Not Eligible
7653	Tetryl Service Magazine and Rest House, DEMOLISHED 1998	Not Eligible
7654	Tetryl Pelleting House, DEMOLISHED 1998	Not Eligible
7655	Unidentified Industrial Building, DEMOLISHED 1998	Not Eligible
7656	Vacuum Sweep House, DEMOLISHED 1998	Not Eligible
7657	Vacuum Pump House, DEMOLISHED 1998	Not Eligible
7658	Vacuum Sweep House, DEMOLISHED 1998	Not Eligible
7659	Vacuum Pump House, DEMOLISHED 1998	Not Eligible
7662	Service Magazine and Tetryl Pellet Rest House, DEMOLISHED 1998	Not Eligible
7663	Burster Charge Loading and Assembly, DEMOLISHED 1998	Not Eligible
7664	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7665	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7667	Change House, DEMOLISHED 1998	Not Eligible
7668	Boiler House	Not Eligible
7675	Walkway between 7653 and 7654, DEMOLISHED 1998	Not Eligible

7677	Vacuum Pump House, DEMOLISHED 1998	Not Eligible
7678	Vacuum Collection Building, DEMOLISHED 1998	Not Eligible
7680	Vacuum Pump House, DEMOLISHED 1998	Not Eligible
7681	Vacuum Collection Building, DEMOLISHED 1998	Not Eligible
7682	Vacuum Collection Building, DEMOLISHED 1998	Not Eligible
7683	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7684	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7685	Remote Control Switch Station, DEMOLISHED 1998	Not Eligible
7685a	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible

When Maj. Carroll D. Hudson arrived in October of 1941 to assume command of Redstone Ordnance Plant, the requirements for the plant, as established by the Chief of Ordnance, called for the loading and assembly of 75-mm chemical shells, 81-mm chemical mortar shells, 30-pound chemical bombs, and 105-mm chemical shells, as well as the loading and assembly of burster charges for this ammunition (Redstone Ordnance Plant, Vol. 1, ca. 1945). The War Department, Office of the Chief of Ordnance, estimated that the cost of construction, including the installation of equipment, at \$4,810,000. The equipment to be purchased by the contractor was estimated to cost approximately \$100,000, while the engineering fee was to equal \$190,000, making a total estimated package of \$5,100,000. Maj. Hudson was directed to construct all buildings, except the igloos, of a temporary, fire-resistant nature and to use floor plans and equipment layouts that would be furnished by the Ordnance Department (*Redstone Ordnance Plant*, Vol. 1, ca. 1945). He was authorized to spend the following:

<b>Shell Assembly Buildings</b>	<b>Units</b>	<b>Construction Cost, excluding fees</b>
Receiving Building (50 x 300 ft.)	2	\$120,000
Assembly Building (50 x 180 ft.)	2	\$72,000
Packing and Shipping Building (50 x 260 ft.)	2	\$104,000
Propellant Charge Assembly Building (50 x 180 ft.)	2	\$108,000
Powder Service Magazine (20 x 32 ft.)	8	\$20,000
Powder Service Magazine (50 x 120 ft.)	2	\$48,000
Change House (30x75 ft.)	2	\$18,000
Office (50 x 65 ft.)	1	\$13,000
Boiler House (30 x 40 ft.)	1	\$6,000

The total figure did not include the architect's fixed fee or allowances for any contingencies, be they by Architect-Engineer, Construction Quartermaster, or Quartermaster General. It was further estimated that burster assembly buildings (no number given) would cost a total of \$222,000; that storage area buildings would cost a total of \$2,020,000; and that administrative and auxiliary buildings and outside utilities would make up for the rest of the estimated \$5,000,000 (*Redstone Ordnance Plant*, Vol. 1, ca. 1945). Further figures were given for buildings that do not fall within the purview of this report.

Unfortunately for Maj. Hudson, the cost estimates jumped an almost immediate \$2,000,000 because of the nature of the terrain. Most of the area was rolling hills and a high percentage of it proved unsuitable for roads. This was a significant problem, and one that cost the Army dearly. Construction delays were created by extremely cold weather. Gravel was virtually impossible to obtain and construction sites were mired in deep red mud.

Burster Line 1 was scheduled for completion first. Construction at the start proceeded quickly. Line 1 consisted of fifteen buildings, somewhat octagonally arranged on 25 acres (Figure 22). The early buildings probably included a change house (Figure 23), assembly building, magazines, melt and blend buildings (Figure 24), and rest houses (the combination of TNT and tetryl required a period of rest during production so that bubbles could dissipate and it could sufficiently shrink away from its molds). All of the buildings were connected with covered ramps (see Figure 24), and were modifications of standard ordnance design. As WWII progressed, deviation from standard designs was not tolerated. Burster Line 1 was completed in March 1942 (*Redstone Ordnance Plant*, Vol. 1, ca. 1945).

No area maps exist for Redstone Arsenal and, unfortunately, the site blueprints are not very helpful. Although an electrical plan for the ramps connecting all the Line 1 buildings is available, it does not show all the structures on the line. The historical record indicates that Line 1 commenced with fifteen buildings. The electrical plan shows only eleven buildings. Logically, it can be assumed that the remaining four structures were not connected to the line by ramps. They probably were free standing structures, such as vacuum pump houses or small auxiliary offices. A 1990s map of Line 1 shows all the WWII structures recorded in the 1998 Panamerican survey. Any of these could have been one of the missing five structures.

According to the ramp electrical plan for Line 1, the following buildings made up the bulk of the line: Building 7666, probably packing and shipping; Building 7631, probably an office space; Building 7667, the change house; Building 7668, the boiler house; Building 7651, service magazine and rest house; Building 7652, tetryl screening house; Building 7655, service magazine and rest house for blended tetryl; Building 7654, tetryl pelleting house; Building 7662, service magazine and rest house for blended tetryl; Building 7663, loading and assembly; and Building 7676, which no longer exists, but was some type of service building, possibly a magazine.

Figure 22  
Layout of Redstone Arsenal, North Plant, Line 1

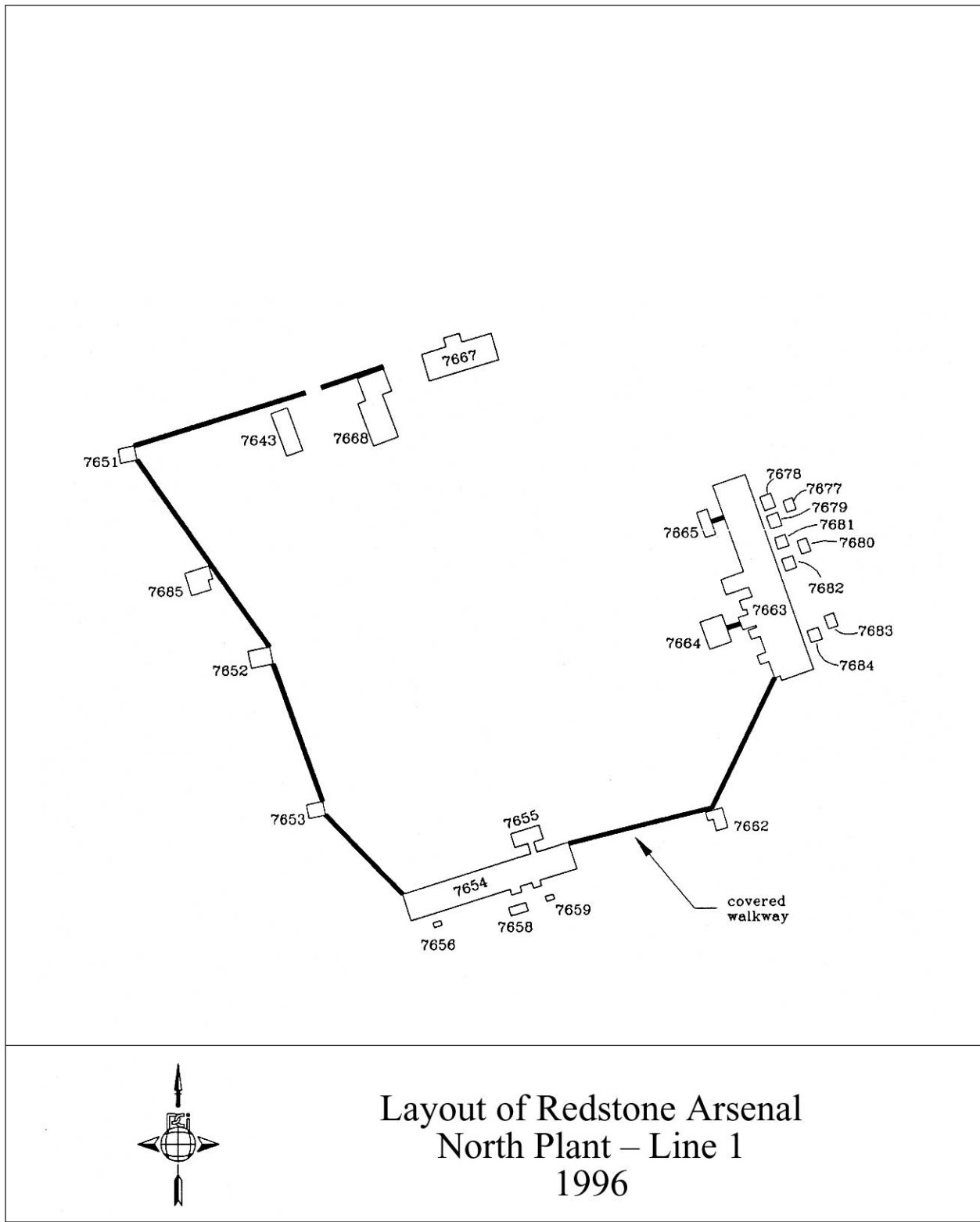


Figure 23  
Photographs of Building 7667



A. Historic photographs of change house, Building 7667, Redstone Arsenal (History of Redstone Ordnance Plant ca. 1945).



B. 1996 photograph of change house, Building 7667, Redstone Arsenal, Panamerican Consultants, Inc., 1998.



Figure 24  
Photographs of Building 7652



A. Early 1950s photograph of tetryl blending building, Building 7652, Redstone Arsenal (Thiokol Corporation ca. 1950).



B. 1996 photograph of tetryl blending building, Building 7652 (Panamerican Consultants, Inc., 1998).

According to the AMC context, Ravenna Ordnance Plant, located in Ravenna, Ohio, was the prototypical WWII shell-loading facility (Cannan et al. 1996). The Ravenna “booster line” seems to be a mirror image of the Redstone burster line. In both the Ravenna Line and the Redstone Line, the process began at a tetryl storage magazine like Building 7651. From here the tetryl was moved to a blending and screening house (Building 7652) where it was blended and screened into molds to achieve an even consistency resulting in its explosive power in the field. Next the blended tetryl was sent to a small rest house (Building 7655). Then the rested tetryl went to the pelleting house (Building 7654) where pellets were produced and strung on prima-cord. Next in the Line 1 series is another rest house (Building 7662) (Figure 25) but it is not known if the pellets rested here after they were made or if the pelleting house was serviced by two separate rest houses for blended tetryl. After the pellets were created, they were sent to the assembly building (Building 7663) and then on to the packing and shipping building (Building 7667). The purpose of Building 7676 is not known; however, the historical record shows that Hudson was forced to complete a building of his own design to accommodate the TNT storage needed for the process, and perhaps it was this structure.

The AMC context for Ravenna does not mention the boiler house, change house, or office that are part of the Redstone line. However, the Ravenna Line would have needed such buildings and perhaps they were not mentioned since they were not part of the actual industrial process.

In 1945, Redstone Ordnance Plant began a large expansion and mechanization program. During this process a melt and pour building, two screening and storage buildings, and a change house were added to Line 1 thereby increasing tetryl burster production to 200,000 pounds per month. After WWII, the Thiokol Corporation leased Line 1 and made additions to Buildings 7662 and 7663 in the form of a large monorail and crane system running between the buildings (Figure 25) (Building Technology, Inc. 1984).

The Ravenna Line and the Redstone Line were constructed of the same basic materials using the similar plans and dimensions. The production structures of usually no more than one to two stories, were built on concrete foundations and exterior walls were made of reinforced concrete, brick or hollow construction tiles. Blow-out walls and roofs were a special feature. Ordnance production lines constructed during the first wave of plant building featured a more permanent style of building. Offices and change houses, however, were simple balloon-framed structures covered in wood clapboard.

**Recommendation and ALSHPO Comments:** Because this was a complete production line with few alterations and non-historic structures at the time of the Panamerican survey in 1998, Line 1 buildings were recommended as eligible to the NRHP as a district under Criteria A and D. The ALSHPO concurred with this decision by letter dated January 13, 1998. At the same time, the ALSHPO also concurred with the demolition of all of the buildings by the RSA





Figure 25  
Photograph of Monorail and Crane System between Buildings 7662 and 7663, Redstone Arsenal

as the ALSHPO felt the buildings had been adequately documented. All of the buildings listed under Line 1 in the Panamerican report, except Building 7668 (the boiler house) were demolished later in 1998.

While these buildings were once eligible as a district, since their destruction, the site no longer meets NRHP standards. Building 7668 is also no longer eligible to the NRHP as it served only as an infrastructure facility and does not represent the entire production line.

### Redstone Arsenal—North Plant: Buildings Associated with Lines 1 and 2

Table 20. Redstone Arsenal—North Plant: Buildings Associated with Lines 1 and 2

Building Number	WWII Use	NRHP Recommendation
7364	TNT Screening Building	Not Eligible
7367	Vacuum Pump House	Not Eligible
7368	TNT and Tetryl Screening Building	Not Eligible
7369	Change House	Not Eligible
7373	TNT Screening Building	Not Eligible
7374	Static Function Test Unit	Not Eligible

These buildings are located between Lines 1 and 2 and may have functioned as a TNT and tetryl production area for the two lines, although its exact use is unknown. According to the AMC context, a typical plant would have a number of major loading lines and a comparable number of auxiliary lines, each physically separated. Like the major lines, this smaller area was connected by covered ramps that served as a monorail or simply as walkways. These ramps are covered more extensively in the section of Line 2.

This line seems to have operated only as a way station for the preparation of the TNT and tetryl because its three main buildings are screening buildings (7364, 7368, and 7373). Since the line was dealing with TNT, a highly poisonous product, workers were required to shower at the end of each shift and any protective clothing used was discarded; hence, the inclusion of a change building (7369). Any smaller support buildings, such as magazines, no longer exist; however, one small vacuum pump house is extant (7367).

The screening buildings, as well as the pump house, are made of hollow brick construction tiles with gabled roofs, as are the majority of the production buildings at Redstone Arsenal. A number of these buildings also feature blow away walls and roofs. The blow away roof is typically segmented by heavy parapets formed as a part of the wall below. These walls were designed to force explosions upward and outward away from the building.

Consistently, the Redstone Arsenal Real Estate Record lists this area of buildings as being constructed in 1945; however, blueprints from Buildings 7368 and 7369 clearly show them as being constructed in 1942 with major additions by Maurice H. Connell and Associates in 1945. Additions to Line 2 included three buildings, plus facilities and

utilities, to increase the capacity of this line to 3,000,000 pounds of tetryl demolition blocks per month (*History of the Huntsville Arsenal* n.d.:127).

**Recommendation:** The historical significance of this group of buildings is limited, as it does not appear to have been a clear production line. In addition all of the structures, except for building 7367, have lost their integrity due to alterations. Given these considerations, it was recommended that these buildings associated with Lines 1 and 2 are not eligible to the NRHP under the World War II context.

**ALSHPO Comments:** The ALSHPO concurred with this recommendation per letter dated May 18, 2001 to the Redstone Arsenal's Directorate of Environmental Management.

### Redstone Arsenal—North Plant: Line 2

Table 21. Redstone Arsenal—North Plant: Line 2

Building Number	WWII Use	NRHP Recommendation
7721	Explosives Magazine, DEMOLISHED 1998	Not Eligible
7722	Tetryl Screening and Blending Building	Eligible
7722a	Unknown Industrial Building	Eligible
7723	Service Magazine and Rest House, DEMOLISHED 2000	Not Eligible
7724	Tetryl Pelleting Building	Eligible
7724a	Service Magazine	Eligible
7724b*	Unknown Industrial Building	Eligible
7725	Service Magazine and Rest House, DEMOLISHED 2000	Not Eligible
7726	Pellet and Pour House, DEMOLISHED 1998	Not Eligible
7726a 1 & 2	Walkway to Pellet and Pour House, DEMOLISHED 1998	Not Eligible
7726a-3*	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7726b*	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7726c*	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7726d*	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7726e*	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7726f*	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7727	Packing and Shipping	Eligible
7728	Change House and Bomb Proof House, DEMOLISHED 1998	Not Eligible
7729	Boiler House, DEMOLISHED 1998	Not Eligible
7729a*	Walkway, DEMOLISHED 1998	Not Eligible
7734	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7735	Vacuum Pump House, DEMOLISHED 1998	Not Eligible
T7737	Unknown Industrial Building	Eligible
7738	Tetryl Screening Building, DEMOLISHED 1998	Not Eligible
7739	TNT Screening Building, DEMOLISHED 1998	Not Eligible

\*Numbers were missing from these buildings, so Panamerican, Inc. assigned these replacements. The number in front of the assigned letter indicates its relationship to the known building. For example, 7724b is near Building 7724.

When Maj. Hudson arrived at Redstone Ordnance Plant in October 1941, he had instructions to build two production lines for the loading of burster tubes. He began

work almost immediately on Line 1; however, as work progressed the Ordnance Department made a number of changes in the actual production process thereby necessitating a slow down in the construction of Line 1. Key civilians from Redstone went to Charleston Ordnance Depot to study the new method and returned with lists of essential equipment. The products were nearly impossible to obtain because of a shortage of critical materials. Arsenal officials scoured the local area for substitutes sometimes resorting to five-and-dime stores until the necessary equipment became available. As the problems were solved on Line 1, the necessary changes were made to Line 2 and as a result, it operated with greater efficiency since it had profited from the mistakes, revisions, and modifications that had occurred on Line 1 (Nolte 1998:85).

In spite of all the changes and modifications that were absorbed into Line 2, it looks remarkably like Line 1 (Figure 26). No site maps exist of the Redstone Arsenal, but an electrical blueprint for the Line 2 ramps provides a fairly good overview of the line's organization (WRS, Blueprint #7733, January 30, 1942). Because this is a blueprint of the ramp's electrical system, it shows only ten buildings and may not include others such as those not connected by ramps.

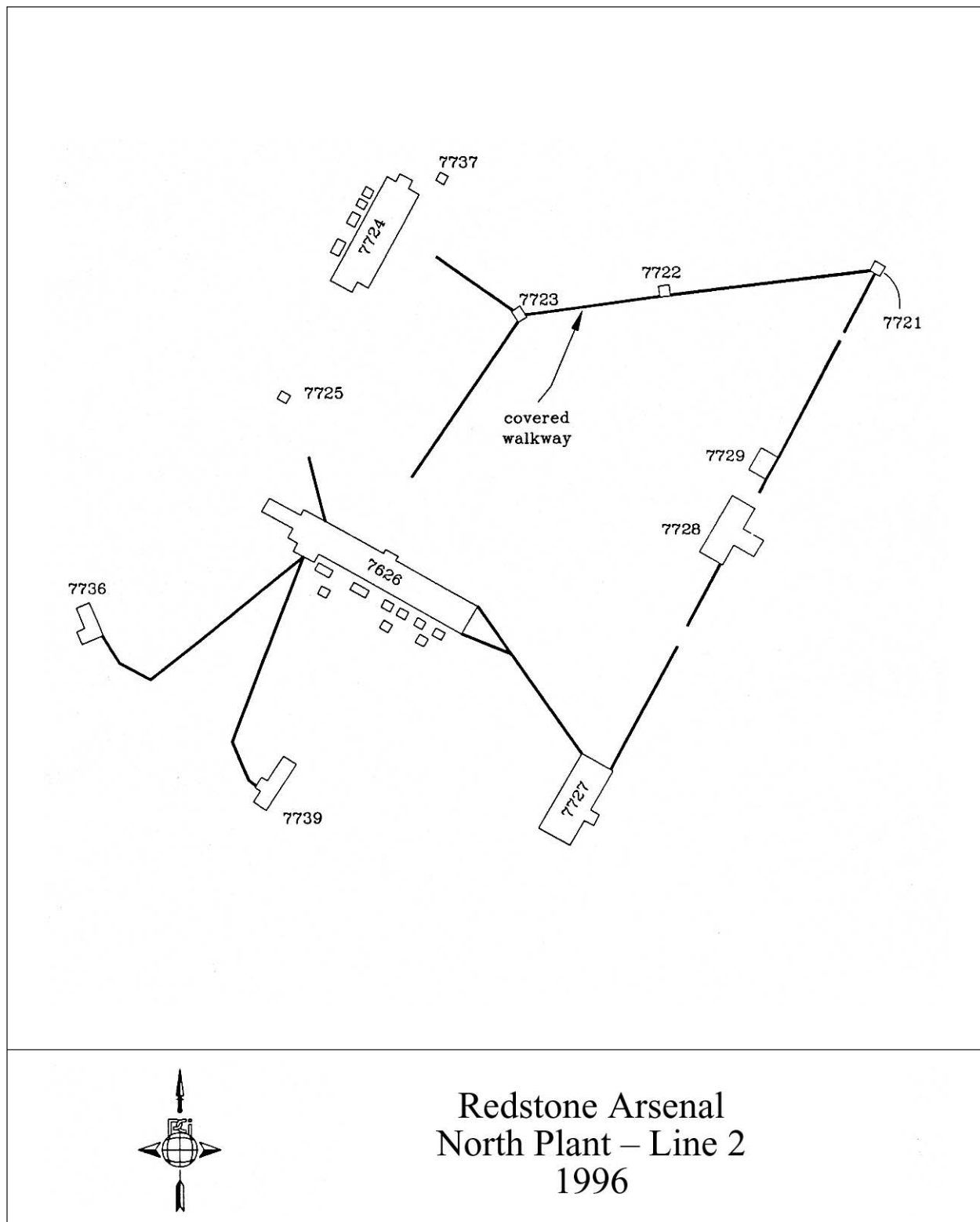
The manufacturing process followed Line 1 to a certain point. Tetryl moved from a service magazine (Building 7721) to a blending and screening building (Building 7722). After being blended, screened, and poured into molds, it was transferred to the service magazine and rest house (Building 7723), where it shrank in its mold. The tetryl was then sent to the pelleting house (Building 7726) (Figure 27), where the true manufacturing took place. Unlike Line 1, the pelleting house was not next to the blending and screening building; but instead was across from the blend building and connected by a ramp. It appears that two supply lines actually fed Line 2. Building 7724 was a large magazine, and Building 7725 was a service magazine and rest house; both of these are connected by ramps to the pelleting house.

Line 2 had a shipping building (Building 7727), a change house (Building 7728), and a boiler house (Building 7729) like Line 1. The only real difference is in the apparent flow of work. Line 2 also featured a larger number of covered ramps than Line 1. These ramps are in two basic sizes, 6 ft. 6 in. wide and 13 ft. wide. A number of blueprints detail these sizes and their uses (Figure 28).

WRS Blueprint #7562 clearly shows that the wider ramp was used as a monorail system that proved to be a stable method of moving volatile tetryl from building to building. In the case of Line 2, the rested tetryl had to move across several acres to the pelleting building. By the time the lines went into production, the open sides were covered by Cel-o-Glass. This is not a true glass; instead, it is a type of brittle opaque plastic embedded in a screen mesh. It blocked the wind and rain and helped keep the occasional bitter winter temperatures at a bearable level.

The narrower ramp probably functioned as a walkway, although reminiscences from plant workers seem to indicate that a certain amount of daily work was done on these ramps. The 700 blueprint series features two types of narrow walkways: the open and enclosed walkway (Kirv 1992). Covered walkways for the workers were also a necessity since they had to walk across several acres just to get to a work site. After a

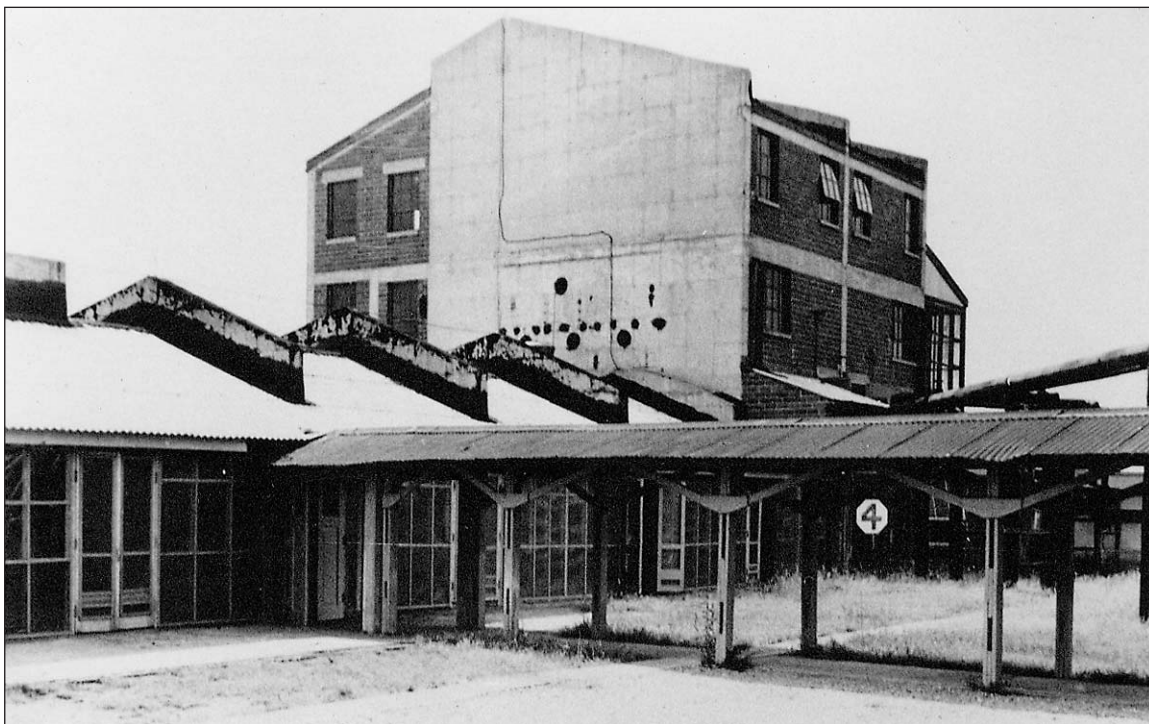
Figure 26  
Layout of Redstone Arsenal, North Plant Line 2



Courtesy of Panamerican Consultants, Inc., 1998



Figure 27  
Photographs of Building 7726



A. Early 1950s photograph of melt and pour building, Building 7726, Line 2, Redstone Arsenal (Thiokol Corporation ca. 1950).



B. 1996 photograph of melt and pour building, Building 7726, Line 2, Redstone Arsenal (Panamerican Consultants, Inc., 1998).

Figure 28  
Photographs of Covered Walkways at Redstone Arsenal



A. Early photograph of monorail system in covered ramp, Redstone Arsenal (History of Redstone Ordnance Plant ca. 1945).



B. Redstone Arsenal, Line No. 2, Buildings 7722 and 7723.

rain the line areas were awash in a sea of red mud that made walking virtually impossible.

During Redstone Arsenal's 1945 expansion and mechanization program, Line 2 received three new production buildings, storage facilities, and related utilities. After WWII, the Thiokol Corporation leased Line 2 and made a number of different additions and changes primarily through the use of earthen mounds as blast barriers (Building Technology, Inc. 1984).

The buildings on Line 2 were constructed of the same basic materials using similar plans and dimensions as Line 1. The production structures were built on concrete foundations and exterior walls were made of reinforced concrete, brick, or hollow construction tiles. Blow out walls and roofs were a special feature. One major building difference between Line 1 and 2 was Line 2's pellet and pour house, Building 7726 (Figure 27). The eastern end of this structure soared a number of stories above the rest of the structure. The exact purpose of this portion of the building is unknown. The change house (7728) was a simple balloon-frame structure covered in wood clapboards.

**Recommendation and ALSHPO Comments:** At the completion of the Panamerican report in 1998, the structures within this production line were intact and unchanged and clearly illustrated the process of burster charge production during World War II. They recommended NRHP eligibility under Criterion A and D. The ALSHPO concurred with this decision in January 1998, but also concurred with the demolition of fifteen of the twenty-five buildings listed here. The ALSHPO concurred that the affected buildings had been adequately documented prior to their demolition in 1998. The fifteen buildings listed under Line 2 include: 7721, 7726, 7726a 1&2, 7726a3, 7726b, 7726c, 7726d, 7726e, 7726f, 7728, 7729, 7729a, 7734, 7738, and 7739. Two additional buildings (7723 and 7725) were demolished by mistake in 2000. In New South Associates 2001 report, they recommended that the buildings actually are eligible under Criteria A and C rather than D since that Criterion is used primarily for archaeological properties. The Directorate of Environmental Management should consult with ALSHPO for the proper mitigation path for the remaining buildings within this NRHP eligible historic district to ensure that like or similar documentation is prepared to what was completed prior to the 1998 demolition of the other fifteen contributing resources. Such documentation should aim toward a full explanation of the process of burster charge manufacture.

### Redstone Arsenal—North Plant: Line 5

Table 22. Redstone Arsenal—North Plant: Line 5

Building Number	WWII Use	NRHP Recommendation
S7600	Unknown Industrial Building	Not Eligible
7601	155mm Chemical Shell Receiving Building	Not Eligible
7602	Burster Service Magazine, DEMOLISHED 1998	Not Eligible
7603	155mm Chemical Shell Assembly Building, DEMOLISHED 2000	Not Eligible
7604	Boiler House, DEMOLISHED 1999	Not Eligible
T7605	155mm Chemical Shell Line Office, DEMOLISHED	Not Eligible



	1998	
7606	Change House, DEMOLISHED 1998	Not Eligible
7607	Walkway, DEMOLISHED 1998	Not Eligible
7608	155mm Chemical Shell Dunnage Shed and Raw Materials Storage, DEMOLISHED 1999	Not Eligible
7609	155mm Chemical Shell Paint Storage Building	Not Eligible
7610	155mm Chemical Shell Burster Service Magazine	Not Eligible
7614	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7615	Vacuum Pump House, DEMOLISHED 1998	Not Eligible
7616	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7617	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7618	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible

Designed as part of the 1942 expansion program for the assembly of 155-mm chemical bombs, this line was completed and operating in early 1943. The line as drawn by Maurice H. Connell and Associates is very different from the other two chemical loading lines (Lines 3 and 4). Line 5 is rectangular in form and its boiler house (Building 7604) and change house (Building 7606) were connected to the line via a system of covered ramps unlike Lines 3 and 4. One significant difference between Line 5 and all the others was the presence of service magazines that had semi-circular earth berms built around them. This also occurred on Huntsville Arsenal during WWII. Blueprints for the standard magazines do not illustrate this feature, and it can only be assumed that particular circumstances warranted the extra protection of earthen mounds. During the 1945 expansion, Line 5 received a new paint storage building and other modifications that more than tripled its production capacity from 58,000 shells per month to 190,000 (Building Technology, Inc. 1984).

At the completion of the Panamerican, Inc. report in 1998, Line 5 appeared to have changed drastically, and as a consequence, it was very difficult to actually find the original buildings and site plan. These changes were poorly documented leading to a lack of knowledge about a number of small buildings attached to the line and seemingly of WWII vintage.

As with all the other production line buildings, Line 5's buildings were constructed using the same building materials and forms. Structures such as the loading and assembly buildings featured blow out walls and roofs, as well as multiple rooflines on a single building. The buildings, depending upon their function, were of red brick, hollow construction tiles and wood clapboards.

**Recommendation:** Half of this line was demolished in 1998 making its eligibility to the NRHP questionable. Many of the remaining buildings have also been altered and the line has served a variety of uses throughout its history, which further jeopardizes its integrity. Given the above, the remaining buildings of Plant Line 5 are not recommended eligible to the NRHP under the World War II context.

**ALSHPO comments:** ALSHPO concurred that Buildings 7602, 7605, 7606, 7607, 7614, 7615, 7616, 7617, and 7618 were ineligible to the NRHP by letter dated January 13, 1998. Within the same document, they then gave their concurrence to proceed with demolition plans for all of these structures. They also concurred by letter dated December 8, 1999, that buildings 7603, 7604 and 7608 were ineligible to the NRHP and

they have also since been demolished. In another letter dated May 18, 2001, they concurred that Buildings 7601, 7609, and 7610 are not eligible to the NRHP under the WWII context.

### Redstone Arsenal—North Plant: Buildings Associated with Lines 1 and 5

Table 23. Redstone Arsenal—North Plant: Buildings Associated with Lines 1 and 5

Building Number	WWII Use	NRHP Recommendation
7621	Rest House #1, DEMOLISHED 2000	Not Eligible
7622	Rest House #2, DEMOLISHED 2000	Not Eligible
7623	Rest House, DEMOLISHED 2000	Not Eligible
7624	Rest House	Not Eligible
7641	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7643	Paint and Spray Building, DEMOLISHED 2000	Not Eligible
7644	Unknown Industrial Building, DEMOLISHED 1999	Not Eligible
7645	Unknown Industrial Building, DEMOLISHED 2000	Not Eligible

It is clear by the organization of Buildings 7621, 7622, 7623, and 7624 that this is some type of line support area. Unfortunately, the function of this auxiliary line is not clear.

The Redstone Arsenal Real Estate Records show that Building 7621 was a rest house. Its construction and size as well as its attendant structures seem to indicate that it could have actually been a pelleting building, although other sources suggest that it was an igniter prep building. This would make sense given the three outlying, but connected, rest houses. A pelleted product would have to “rest” to ensure the bubbles were gone and any shrinkage of the product would be rectified. All of these structures are built of hollow brick construction tiles with some later additions made in concrete block.

Building 7641 was a large two-story, simple drop, wooden clapboard, end-gabled building (Figure 29). The building’s WWII use is unknown, although it does resemble a barracks. In 1959 the structure was used to store inert materials and it later served as a lab and administration building (Redstone Arsenal Command Historian Office, historical files).

Building 7643 was a paint and spray building built by Maj. Hudson for \$5,235 (Nolte 1998:95). Paint and spray buildings were used in a number of different ways. It appears that sometimes the wooden cases for ammunition were labeled with stencils. Other times it seems that the paint was stored, mixed, and distributed from this type of building. Clearly, the paint and spray building was attached to some type of line because its covered ramps are still extant.

**Recommendation:** Although most of these buildings are unaltered, it seems likely that they hold no architectural or historical value since they were not associated with any one particular production process. They are recommended as not eligible to the NRHP under the World War II context.

Figure 29  
Photographs of Buildings 7641



A. Early 1950s photograph of Building 7641, between Line 1 and Line 5, Redstone Arsenal (Thiokol Corporation ca. 1950).



B. 1996 photograph of Building 7641, between Line 1 and Line 5, Redstone Arsenal (Panamerican Consultants, Inc., 1998).

**ALSHPO Comments:** The ALSHPO concurred in a letter dated January 13, 1998 that Building 7641 was not NRHP eligible under the WWII context; it was cleared for demolition in 1998. A similar letter dated December 8, 1999 concurs the same for Buildings 7621, 7622, 7623, 7644, and 7645. By letter of concurrence dated May 18, 2001, the ALSHPO agreed that the remaining building (7624) is also not eligible to the NRHP under the WWII context.

### Redstone Arsenal—North Plant: Igloo Area

Table 24. Redstone Arsenal—Igloo Area

Building Number	WWII Use	NRHP Recommendation
7301-7307	7 units; 60 ft. igloos	Not Eligible
7311-7318	8 units; 60 ft. igloos	Not Eligible
7321	40 ft. igloo	Not Eligible
7322-7325	4 units; 80 ft. igloos	Not Eligible
7326-7327	2 units; 40 ft. igloos	Not Eligible
7331-7335	5 units; 40 ft. igloos	Not Eligible
7341-7343	3 units; 40 ft. igloos	Not Eligible

Storage facilities made up the bulk of Colonel Hudson's expenditures. He was authorized to construct warehouses, magazines, and igloos. He first built fifteen igloos (40 x 26 x 9 feet) with 10,001 cubic feet of storage space. Later an additional fifteen igloos (60 feet in length) were constructed followed by a few 80-foot examples (Nolte 1998:98). Igloos are barrel-arched, earth-covered magazines used for storing explosives. Each igloo is identical in width and all have the same double warehouse doors and concrete facings. The history of igloo construction will be discussed in more detail in the Gulf Chemical Warfare Depot section of this report.

The igloos were built well away from the actual production lines for safety reasons. The distances between each igloo and the number in each grouping was specifically dictated.

**Recommendation:** Although these igloos remain in good condition in a restricted area, they do not illustrate the ultimate purpose of the Redstone Arsenal—the manufacture of chemical weapon shells. They were simply storage spaces for complete rounds and explosive components. Given this, the igloos should not be considered eligible to the NRHP under the World War II context.

**ALSHPO comments:** By letter of concurrence dated May 18, 2001, the ALSHPO agreed that all buildings in the Redstone Arsenal—North Plant, Igloo Area are not eligible to the NRHP under the WWII context.

### Redstone Arsenal—North Plant: Miscellaneous Buildings

Table 25. Redstone Arsenal—North Plant: Miscellaneous Buildings

Building Number	WWII Use	NRHP Recommendation
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Number		
T7292	Guard Building	Not Eligible
7634	Unknown Industrial Building (probably mechanical equipment), DEMOLISHED 1999	Not Eligible
7640	Unknown Industrial Building, DEMOLISHED 2000	Not Eligible
S7642	Unknown Industrial Building, (probably solvent storage shed), DEMOLISHED 1998	Not Eligible
T7648	Guard House, DEMOLISHED 1999	Not Eligible
T7649	Guard House	Not Eligible
T7670	Guard House	Not Eligible
T7702	Guard House	Not Eligible
T7862	Guard House	Not Eligible

When Maj. Hudson assumed the task of building Redstone Ordnance Plant, his immediate concerns were the creation of two production lines and the requisite structures to support the lines. He was instructed to build administrative and utility buildings of a temporary nature (*Redstone Ordnance Plant*, Vol. 1, c. 1945). The *Historical Record of Redstone Ordnance Plant* makes clear, however, that “temporary buildings with proper maintenance... should last for an indefinite number of years” (Office of the Chief of Ordnance, 1941-1946). All of the utility buildings constructed on Redstone Arsenal were modifications of standard ordnance design. It also can be assumed that many of the temporary buildings were actually part of the U.S. Army’s 700 and 800 series of generic type structures.

Six buildings (Buildings 7292, T7648, T7649, T7670, T7702, and T7862) of the nine miscellaneous buildings covered in this report are guard or sentry posts. One of these, Building 7292, was placed on skids so that it could be moved. Many sentry boxes were built to be transportable, and numerous boxes are scattered throughout Redstone Arsenal. The Architect’s Building Schedule does not exist for Redstone Ordnance Plant, but the schedule for Huntsville Arsenal shows that twenty-two such boxes were made. Most of the guardhouses are small frame, rectangular structures clad with drop siding. They generally have numerous six-over-six sash windows and half-glass doors allowing for full range of visibility around the building.

All of these guard or sentry structures appear to fall within the Department of Defense memorandum of agreement with the National Council on Historic Preservation and the National Conference of State Historic Preservation Officers allowing the demolition of certain types of WWII temporary structure if they have no other special significance. They have no unique architectural features and were probably a common building form repeated at military posts across the country. They do not hold any unique role in the evolution of Redstone Arsenal, the state or the nation.

Building 7634 served an unknown industrial purpose during WWII, but possibly housed mechanical equipment since this was its role during the Korean War. It was constructed of hollow brick construction tiles, the most popular building material on Redstone Arsenal’s production lines. It was probably a mechanical equipment room as it is today. Numerous small mechanical and utility buildings, like this one, were constructed during WWII. This particular building held no special role in the evolution of Redstone and was therefore, demolished in 1999.

Building S7642 was another temporary structure built to support the production lines. Its WWII use is unknown, although it may have been used as a solvent storage shed. Its building style is consistent with any WWII temporary military architecture. It held no unique role in the development of Redstone Arsenal and was also demolished in 1998.

Finally, Building 7640 was a square, concrete block building with a shed roof and corrugated metal siding. A concrete block firewall divided the building in half and extends above the roofline and past the side elevations. Portions of the building were screened and there was a modern deck on the north façade. This building served no unique role at Redstone Arsenal and was demolished in 2000.

**Recommendation:** While most of these buildings are essentially unaltered and some served vital security roles, they do not represent the mission of the Redstone Arsenal and therefore, hold no historical value. Given the above, the miscellaneous buildings at the north plant were recommend not eligible to the NRHP under the WWII context.

**ALSHPO comments:** Per letter dated January 13, 1998, the ALSHPO concurred that Building 7642 was ineligible to the NRHP under the WWII context and it was later demolished. The ALSHPO stated the same conclusion for Buildings 7634 and 7640 in a similar letter dated December 8, 1999 and these were also demolished. Buildings 7292, 7648, 7649, 7670, 7702, and 7862 fall under the Department of Defense Memorandum of Agreement with the National Council on Historic Preservation and the National Conference of State Historic Preservation Officers allowing the demolition of certain types of WWII temporary structure if they have no other special significance.

### Redstone Arsenal—South Plant: Line 3

Table 26. Redstone Arsenal—South Plant: Line 3

Building Number	WWII Use	NRHP Recommendation
7529	Elevated Service Magazine	Eligible
7530	Elevated Service Magazine	Eligible
7531	Elevated Service Magazine	Eligible
7551	Chemical Shell Receiving Building	Eligible
7551a	Chemical Shell Receiving Building	Eligible
7552	Standard Service Magazine	Eligible
7553	Assembly, Packing, and Shipping Building	Eligible
7554	Assembly, Packing, and Shipping Building	Eligible
7555	Propellant Charge Building DEMOLISHED 2001	Not Eligible
7556	Primer Service Building	Eligible
7557	Men's Locker Room	Eligible
7558	Powder Service Building/Office	Eligible
T7561	Locker Rooms and Change House, DEMOLISHED 1998	Not Eligible
7565	Unknown Industrial Building DEMOLISHED 2002	Not Eligible
7567	Unknown Industrial Building	Eligible
7569	Remelt Munitions Building, DEMOLISHED 1998	Not Eligible
7585	Unknown Industrial Building	Eligible

7587

Unknown Industrial Building

Eligible

In January 1942, the Office of the Chief of Ordnance approved the layout, buildings, and location of Lines 3 and 4 and construction began in February. In April, Line 3 had been completed and actual operation began on April 28, 1942 (Figure 30). Lines 3 and 4 were designed for the purpose of chemical shell loading and assembling. All the utility buildings at Redstone Arsenal were modifications of standard ordnance design to meet the special requirements of a chemical shell assembly line. Line 3 produced 105-mm chemical shells, smokes, 105-mm howitzer shells, M2, M2AL, and M-69 cluster incendiary bombs (*Redstone Ordnance Plant*, Vol. 1, ca. 1945).

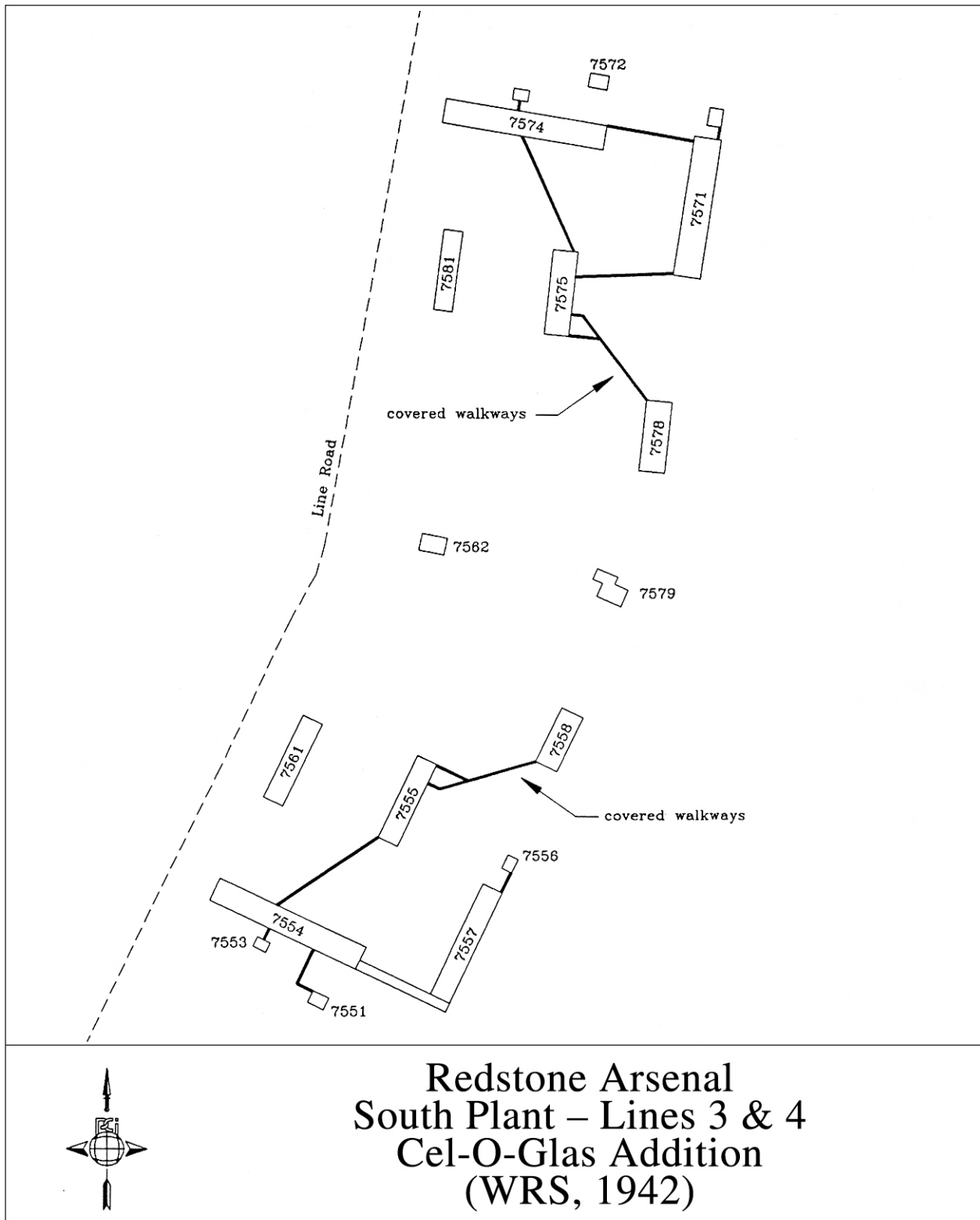
The chemical shell lines were quite different from the burster lines. They were much smaller and their structures were closer to each other. In fact, Lines 3 and 4 shared a boiler house, Building 7579. Another significant difference was the actual process involved in chemical shell loading. After inspection and testing at Lines 3 and 4, the empty shell and burster casings were shipped to Huntsville Arsenal, about ten miles away by rail, where the shell casings were filled with the proper chemicals. These chemicals included, but were not limited to, mustard (H) gas and white phosphorus (WP). The shells were filled and sealed on the Huntsville Arsenal lines. They were then returned to Redstone Arsenal to become one of the components for complete rounds assembly (*Redstone Ordnance Plant*, Vol 1, c. 1945).

The careful inspection of the filling process at Huntsville Arsenal was not always adequate. Mustard gas shells in particular had a “leaker” problem. In June 1943, 70-mm mustard gas bombs leaked on Line 3, causing a great hazard. The line had to be shut down and decontaminated, and five magazines were closed permanently. This and other leakage problems caused Huntsville Arsenal to send decontamination crews with its filled shells back to Redstone Arsenal. When leaks were discovered on the train ride to the ordnance plant, the train stopped and they were simply buried on the spot. Today, random unexploded ordnance (RUO), can still be found on the post.

Hudson made many modifications to the Picatinny Arsenal recommendations for equipment and materials. To fill the large orders with the materials and parts he had available, he decided to streamline the shell loading method already in place. Instead of the cumbersome handling and movement of shells through each stage, shells were placed into racks that remained stationary during each phase of assembly. The racks, which were attached to trucks, could then be moved with ease from station to station. Hudson decided to test these modifications for one week against Line 4’s regulation Picatinny equipment. At the end of the week, the “Redstone Line” had proved more efficient by 25 percent, and, as a result, all chemical ammunition loading lines at the installation began using the Redstone designed equipment. The new method also gained national attention and Line 3 became known as the “Redstone Line” (Baker and Hughes 1993 , Nolte 1998:104).

In 1944 the mission of Redstone Arsenal was expanded to include the screening and renovation of chemical artillery ammunition returned from overseas (ARFO) and in depots in the United States. In this same year, Redstone Arsenal submitted an extensive

Figure 30  
Layout of Redstone Arsenal, South Plant, Lines 3 and 4





mechanization program for approval by the Ordnance Department. The project involved the reconstruction, alteration, and addition of equipment for all production lines and the ARFO renovation line. It was expected that these changes would greatly increase production schedules with less personnel. Consequently, the Secretary of War approved \$500,000 project for the mechanization of Redstone Arsenal's production lines in late 1944. Line 3 alterations included new buildings for reprocessing ammunition, paint storage and extensive renovation of existing buildings to adapt the line to mechanized assembly of 105-mm shells. Some of these changes were part of a larger \$5.5 million expansion program announced in January 1945 (Building Technology, Inc. 1984).

No site map exists for Line 3; however, a blueprint of the Cel-o-Glass installation provides a view of the general layout of Lines 3 and 4. Cel-o-Glass was installed almost immediately after the lines were completed as a way of enclosing primarily the ramps (WRS, Blueprint #7555, April 9, 1942).

It appears that the chemically loaded shells were received in Building 7551 (chemical shell receiving building), which had its own primer service building, and were then sent down a ramp to the propellant charge building (Building 7555), which was serviced by the powder service magazine (Building 7557). The shells then went down a ramp to the assembly, packing, and shipping building, Building 7554 (Figure 31), where they were prepared for service. Building 7554 was serviced by Building 7553 (Figure 32) and a standard powder magazine, Building 7552. Building T7561 (change house) and Building 7579 (boiler house) were not connected to the line by ramps the way they were on Lines 1 and 2. Building 7555 was demolished by mistake in 2001 and Building 7565 was destroyed by fire in 2002. 7565 was cleared for demolition in a 1998 MOA.

All of the buildings on Line 3 were constructed of the same materials as its counterparts. Structures like the change house and receiving building are large but uncomplicated balloon-framed buildings with simple wooden clapboards and a varying roofline. The service magazines are made of red, hollow, brick construction tiles, and every building that handled the shells features blow-out construction in walls and roofs.

**Recommendation:** The buildings remaining from this line are intact and have few alterations. They illustrate the production facilities and function of the Redstone Arsenal and therefore are eligible to the NRHP under Criteria A and C. They are associated with WWII and the buildings on the line embody a distinctive method of construction unique to the manufacture of chemical weapon shells. It is recommended that the resources that compose plant line 3 should be considered eligible to the NRHP as a district under Criteria A and C.

**ALSHPO comments:** Per letter dated May 18, 2001, the ALSHPO concurred that all of these Line 3 buildings are eligible to the NRHP under the WWII context. Buildings T7561 and 7569 were demolished after recordation as per letter of concurrence dated January 13, 1998.

Figure 31  
Photographs of Buildings 7554



A. Early photograph of packing and shipping building, Building 7554, showing Cel-O-Glas additions, Line 3, Redstone Arsenal (History of Redstone Ordnance Plant ca. 1945).



B. 1996 photograph of packing and shipping building, Building 7554, Line 3, Redstone Arsenal (Panamerican Consultants, Inc., 1998).

Figure 32  
Photographs of Buildings 7553



A. Early photograph of service building, Building 7553, Redstone Arsenal (History of Redstone Ordnance Plant ca. 1945).



B. 1996 photograph of service building, Building 7553, Redstone Arsenal (Panamerican Consultants, Inc. 1998).

## Redstone Arsenal—South Plant: Line 4

Table 27. Redstone Arsenal—South Plant: Line 4

Building Number	WWII Use	NRHP Recommendation
7571	Chemical Shell Receiving Building	Not Eligible
7572	Standard Magazine, DEMOLISHED 1998	Not Eligible
7574	Assembly, Packing, and Shipping Building, DEMOLISHED 1998	Not Eligible
7575	Propellant Charge and Receiving Building	Not Eligible
7578	Storage	Not Eligible
7579	Lines #3 and #4 Boiler House	Not Eligible
7581	Change House	Not Eligible

Line 4 began operations on August 3, 1942. Like Line 3, Line 4 was designed for the purpose of chemical shell loading and assembling. The line produced 105-mm chemical shells, smokes, 105-mm howitzer shells, M-2, M1-AL, and 81-mm mortar shells (*Redstone Ordnance Plant*, Vol. 1, ca. 1945). Line 4 received an unknown number of additions and changes to boost its production capacity to 650,000 rounds of 81-mm chemical mortar shells per month in 1945 (Building Technology, Inc. 1984).

No site map exists for Line 4; however, like Line 3, a blueprint of the Cel-o-Glass locations shows the general layout. Line 4 is depicted as a reverse image of Line 3. It appears that the chemical loaded shells were received in Building 7571 (the chemical shell receiving building) which had its own primer service building; the shells were then sent down a ramp to the propellant charge building (Building 7575) which was probably paired with a powder magazine; however, the magazine no longer exists. The shells were then transported down a ramp to the assembly, packing, and shipping building (Building 7574) for final preparations. Building 7574 was serviced by standard powder magazine (Building 7572) and another small service building that does not exist today. Building 7581 (the change house) and Building 7579 (the boiler house) were not connected to the line by ramps as they were on Lines 1 and 2.

All of the buildings on Line 4 were constructed of the same materials as the others, but the line has been changed dramatically since its initial construction. The covered ramps are gone, and the large buildings on the line have undergone numerous conversions to the point that the WWII fabric is not evident. Only the basic form suggests the buildings' actual ages.

Immediately to the east of Line 4 is an L-shaped group of buildings that appear to be a part of the line. They were, however, built in the mid to late 1950s as part of the growing Rohm and Haas complex. This company occupied the line between 1949 and 1970 and did significant work on rocket fuel production.

**Recommendation:** Line 4 was built for the same use as Line 3 with more or less the identical layout. This line, unlike Line 3, has been altered over time and has lost



many buildings and the covered walkways that once connected the individual structures. As a result of this loss of integrity, Line 4 is not recommended eligible to the NRHP under the World War II context.

**ALSHPO comments:** Through a letter of concurrence dated January 13, 1998 from the ALSHPO, Buildings 7572 and 7574 were declared not eligible to the NRHP under the WWII context and cleared for demolition. A similar letter dated January 29, 1999 provided concurrence for Building 7578. The ALSHPO also agreed that Building 7571 is not eligible to the NRHP under the WWII context per letter dated August 15, 2000. In another letter dated May 18, 2001, the ALSHPO agreed that buildings 7575, 7579, and 7581 are also not eligible to the NRHP under the WWII context.

### Redstone Arsenal—Administrative Area

Table 28. Redstone Arsenal—Administrative Area

Building Number	WWII Use	NRHP Recommendation
7121	Officers' Housing	Not Eligible
7122	Officers' Housing	Not Eligible
7123	Officers' Housing	Not Eligible
7124	Officers' Housing	Not Eligible
7125	Officers' Housing	Not Eligible
7126	Officers' Housing	Not Eligible
7127	Officers' Housing	Not Eligible
7128	Officers' Housing	Not Eligible
7129	Officers' Housing	Not Eligible
7130	Officers' Housing	Not Eligible
7586	Sewage Lift Station	Not Eligible

The 1996 AMC context indicates that the typical ordnance plant had an administrative area that featured a main administrative building and various support structures as well as a residential area where primary personnel resided. Redstone Arsenal combined the administrative and residential areas into one component, located in a loop off Redstone Road. Like other ordnance plants, the administrative area at Redstone Arsenal featured a large sprawling one story E-shaped headquarters building (7101) (Figure 33), a clinic/hospital, and the bachelor officers' quarters (7131). All of these have since been demolished. The 1942 map of Redstone Arsenal also shows two small buildings that have not yet been identified and no longer stand.

Although the plant areas and their attendant warehouses and magazines were the top construction priority, the building first completed on November 1, 1941, was the bachelor officers' quarters (Building 7131). This was probably a standard military design barracks that could be completed in just a number of weeks. Building 7131 began its existence as a combined quarters for staff members and a temporary administration building. Except for a small kitchen and dining room, the building contained small rooms of identical design which could be used as office or living quarters. Building 7131 served in this dual capacity until the headquarters building (7101) was completed in March 1942. The need for housing of any type was critical since the city of Huntsville could not accommodate the growing demands of its

burgeoning new population seeking employment at the three posts. While the official records may indicate that the factory operations took precedent, in reality housing became the most critical need (Redstone Arsenal Command Historian Office, historical files).

While the BOQ at first provided housing for anyone and everyone, the general staff and its families required something more. The building of staff quarters was not merely a frivolous perk for officers. General staff were on call 24 hours a day and needed to be housed near the plant lines. Col. Hudson's house, Building 7123, provided him the best view of Lines 3 and 4 where he conducted his experiments on efficiency and equipment (Figure 33). The staff housing was apparently built in two waves, the first being Buildings 7121-7125 and the second being the smaller structures, Buildings 7126-7132.

All of the original officers' housing is intact and as mentioned previously, is similar to the officer housing at the Huntsville Arsenal. Blueprint #7124 is labeled "standard staff quarters" and includes the first wave of buildings that measured about 618 square feet (see Figure 7). The blueprint shows a small, Colonial Revival ranch with a side gable roof. The house is set on concrete blocks and covered with clapboards. There is an interior, brick chimney and a small, off-center entry porch supported by simple, square, columns with stylized capitols. The six-over-six sash windows have plain drip caps and shutters. Since their construction, some of the porches have been screened, although Col. Hudson's home currently has an inset entrance with no screening. The houses have since been altered with vinyl siding and numerous additions.

The second wave of houses were smaller in square footage but were much like the first and located to the west of the others on their own looped road. They were still connected to the other living areas and shared all the conveniences.

**Recommendation:** The officers' housing is not considered eligible to the NRHP under the World War II context. It has been suggested that Col. Hudson's house (7123) be considered NRHP eligible due to its association with him. Although Col. Hudson was clearly the primary driving force behind Redstone Arsenal's success in WWII, his importance is better represented in the production lines he developed and maintained and not the house he occupied.

**ALSHPO comments:** These buildings were declared not eligible to the NRHP by the ALSHPO in a letter of concurrence dated February 12, 1999 and cleared for demolition.

Figure 33  
Photographs of Buildings 7101 and 7123



A. Early photograph of Redstone Arsenal administration building 7101 (no longer standing), (History of Redstone Ordnance Plant ca. 1945).



B. 1996 photograph of standard officers' quarters, Col. Carroll Hudson's house, Building 7123, Redstone Arsenal (Panamerican Consultants, Inc. 1998).



## Redstone Arsenal—Warehouse Area

Table 29. Redstone Arsenal—Warehouse Area

Building Number	WWII Use	NRHP Recommendation
7103	Engine House, Machine Shop, and Auto Repair	Not Eligible
7104	Utilities and Carpenter Shop	Not Eligible
7105	Steam Plant	Not Eligible
7106	Electrical Equipment Building	Not Eligible
S7107	Gasoline Station and Bulk Storage, DEMOLISHED 1997	Not Eligible
7108	Paint and Oil Storage Building	Not Eligible
7111	Communications Building	Not Eligible
7112	Unknown Industrial Building	Not Eligible
7115	Laundry, DEMOLISHED 1998	Not Eligible
T7118	Medical Detachment Barracks, DEMOLISHED 1996	Not Eligible
7119	Generator Station Building	Not Eligible
7142	Maintenance Shop C	Not Eligible
T7175	Paint and Oil Storage Building	Not Eligible
7403	Inert Storage Warehouse	Not Eligible
7404	Inert Storage Warehouse	Not Eligible
7405	Inert Storage Warehouse	Not Eligible
7406	Inert Storage Warehouse	Not Eligible
7407	Inert Storage Warehouse	Not Eligible
7413	Inert Storage Warehouse	Not Eligible
7414	Inert Storage Warehouse	Not Eligible
7415	Inert Storage Warehouse	Not Eligible
7416	Inert Storage Warehouse	Not Eligible
7417	Inert Storage Warehouse	Not Eligible
7420	Inert Storage Warehouse	Not Eligible
7421	Inert Storage Warehouse	Not Eligible
7422	Inert Storage Warehouse	Not Eligible
7423	Inert Storage Warehouse	Not Eligible
7424	Inert Storage Warehouse	Not Eligible
7425	Inert Storage Warehouse	Not Eligible
7426	Inert Storage Warehouse	Not Eligible
7427	Inert Storage Warehouse	Not Eligible
7430	Inert Storage Warehouse	Not Eligible
7431	Inert Storage Warehouse	Not Eligible
7432	Inert Storage Warehouse	Not Eligible
7433	Inert Storage Warehouse	Not Eligible
7434	Inert Storage Warehouse	Not Eligible
7437	Inert Storage Warehouse	Not Eligible
7440	Inert Storage Warehouse	Not Eligible
7442	Inspection and Testing, Shell Cleaning Building	Not Eligible
7443	Inert Storage Warehouse	Not Eligible
7444	Inert Storage Warehouse	Not Eligible
7445	Inert Storage Warehouse	Not Eligible
7446	Inert Storage Warehouse	Not Eligible
7471	Administration and Change House	Not Eligible

The AMC context indicates that the typical ordnance plant included storage areas for inert materials, warehouses and explosives igloos as well as shop areas for

automobiles and other tasks. In the case of Redstone Arsenal, the storage area was divided into three parts: the aboveground magazine area, the igloo area, and the warehouse area. Although the above-ground magazines were serviced by rail, it appears that the warehouses were where the true staging for shipments out of and into Redstone Arsenal took place. Directly to the southeast of the warehouse area was the classification yard. The buildings are placed nearly end to end and during WWII, railroad tracks ran between them to facilitate loading and unloading of inert materials. This area of Redstone Arsenal must have been exceptionally busy. Daily rail shipments to and from the tightly packed warehouses, auto maintenance shops, carpenter shops, equipment buildings, communication buildings, and laundry surely filled the air with noise and much commotion.

Aside from the actual warehouses, the other structures in this area appear to be typical WWII-era buildings of construction tile or wooden clapboards, most with side gable roofs. Today, many of these structures have been obscured by corrugated metal siding and have been connected to each other by a series of elaborate porches, rooms, or other additions. One of the most interesting of these oddly shaped structures is Building S7107, originally a gas station, it later became an office building. It was built or upgraded (the blueprint does not make it clear) in 1945 with plans by Maurice H. Connell & Associates. In 1955, an old gate house from another area was melded onto the building giving it an interesting rounded triangular shape that was further accented by its position on the corner of Line Road and Redstone Road (Figure 34).

Fortunately, photographs from c. 1942 exist for two of the miscellaneous structures. Building 7108 (then Building A-108) was a paint and oil storage building built of non-flammable materials: construction tiles, and cement (Figure 34). The photograph shows many of the construction tile inert warehouses immediately to the left and behind Building 7108. The problems that Maj. Hudson faced in creating Redstone Arsenal are also readily apparent in the photographs. Red mud covers the entire area, and Line Road, immediately in front of Building 7108, was just a graded, hard-packed dirt road. These raw construction areas probably gave the entire post a strange unfinished look. Building 7118 (then building A-118) is now a fuel station, but supposedly served as a medical detachment barracks (Figure 35). This little building is typical of small administrative type structures created during WWII. It was probably no more than two rooms with an attached storage shed, or perhaps an equipment shed. If this was a barracks space, no more than two people bunked here. Huntsville Arsenal initially provided hospital facilities for Redstone Ordnance Plant, which maintained only an industrial dispensary that did not provide bed care and was probably this building shown in Figure 35. The structure contains a window with the built-in shelf that seems to indicate that work orders or perhaps medications were issued from here. In August 1942, a twenty-nine-room hospital opened directly behind the headquarters building (Redstone Arsenal Command Historian Office, historical files). Building 7118 was demolished before the 1998 Panamerican report was completed.

By far the largest numbers of buildings in this area are inert warehouses. Most of the thirty warehouses are rectangular and measure 240 x 50 feet. They have concrete foundations and side gabled roofs. Although originally constructed of brick tile, approximately twenty of the warehouses are now covered with corrugated metal.

Figure 34  
Photographs of Building 7107 and 7108



A. 1996 photograph of Building 7107, showing odd configuration due to additions, Redstone Arsenal (Panamerican Consultants, inc., 1998)



B. Early photograph of paint and oil storage building, Building 7108, Redstone Arsenal (History of Redstone Ordnance Plant ca. 1945).

Figure 35  
Photographs of Building 7118 and Warehouse Area



A. Early photograph of medical detachment barracks, Building 7118, Redstone Arsenal (History of Redstone Ordnance Plant ca. 1945).



B. Redstone Arsenal, Warehouse Area

Many of the support buildings are also clad with the same siding. These warehouses were built using standard prototypes since the identical building design appears throughout the three posts in various widths and lengths, but the same types of construction materials.

**Recommendation:** While this is certainly an impressive group of structures, some have been altered with new siding. Like the igloo area, they also do not represent the World War II production mission of the Redstone plant. The purpose of the plant is best illustrated in the line areas that are eligible to the NRHP. Given this, these buildings are not recommended as eligible for nomination to the NRHP under the World War II context.

**ALSHPO comments:** By letter of concurrence dated May 18, 2001, the ALSHPO agreed that Buildings 7103, 7104, 7105, 7106, 7108, 7111, 7112, 7119, 7403, 7404, 7405, 7406, 7407, 7413, 7414, 7415, 7416, 7417, 7420, 7421, 7422, 7423, 7424, 7425, 7426, 7427, 7430, 7431, 7432, 7433, 7434, 7437, 7440, 7442, 7443, 7444, 7445, 7446, and 7471 are not eligible to the NRHP. Building 7115 was determined to be not eligible to the NRHP under the WWII context per letter from ALSHPO dated February 20, 1998 and demolished later that year.

### Redstone Arsenal—Magazine Area

Table 30. Redstone Arsenal—Magazine Area

Building Number	WWII Use	NRHP Recommendation
7201	Finished Ammunition Magazine	Not Eligible
7202	Finished Ammunition Magazine	Not Eligible
7203	Finished Ammunition Magazine	Not Eligible
7204	Finished Ammunition Magazine	Not Eligible
7205	Finished Ammunition Magazine	Not Eligible
7206	Finished Ammunition Magazine	Not Eligible
7207	Finished Ammunition Magazine	Not Eligible
7211-7216	Finished Ammunition Magazine, 6 units	Not Eligible
7221-7227	Finished Ammunition Magazine, 7 units	Not Eligible
7231-7237	Finished Ammunition Magazine, 7 units	Not Eligible
7245-7247	Finished Ammunition Magazine, 3 units	Not Eligible
7261-7266	Finished Fuse and Primer Storage Buildings, 6 units	Not Eligible

Unlike the smaller, 6 x 6-foot magazines at the Huntsville Arsenal, these structures are the same size as the warehouses located adjacent to them and measure 240 x 51 feet. They are constructed of brick tile with multiple sliding warehouse doors. Some also have doors on their gable ends. This building type is one of the most frequently found structures on all three WWII posts.



Five finished fuse and primer storage buildings, which measure 43 x 28 feet, are also included in this group. They are constructed of brick tile and have a central door and a gable roof. The warehouses are situated at safe intervals from one another as they housed explosive components and not inert materials. All of these buildings are unchanged and are now part of a cattle pasture.

**Recommendation:** Like the other storage facilities at this installation, these buildings do not represent the primary mission of the Redstone Arsenal. The production line buildings better illustrate the World War II function and importance of this post. Given this, it is recommended that the magazines at the Redstone Arsenal are not eligible to the NRHP under the World War II context.

**ALSHPO comments:** Per letter of concurrence dated May 18, 2001, the ALSHPO agreed with this recommendation.

### Redstone Arsenal—Line 6

Table 31. Redstone Arsenal—Line 6

Building Number	Historic Use	NRHP Recommendation
8971	Shell Assembly Building, DEMOLISHED 1996	Not Eligible
8972	Assembly and Packing Building, DEMOLISHED 1997	Not Eligible
8973	Shell Assembly Building	Not Eligible
8974	Paint Storage	Not Eligible
8975	Propellant Weighing and Storage Building	Not Eligible
8977	Boiler House	Not Eligible
8978	Change House, DEMOLISHED 1999	Not Eligible

During the summer of 1943, the industrial facilities' total production exceeded expectations and stockpiles of materiel were expanding. By the fall, the War Department decided that production at the GOCO facilities was too great and a program of cutbacks and closings began at these plants. Apparently, these cutbacks affected only GOCOs since Redstone Arsenal, a GOGO, was not a part of this reduction.

After D-Day, however, the need for ammunition increased dramatically and stockpiles were depleted. Labor shortages became critical and enlisted men were furloughed to work production lines. Ammunition production was doubled, but a deficit still remained and in 1944 ammunition had to be rationed. To meet the demand, production was increased at facilities that remained open by constructing new lines and expanding and mechanizing those that already existed.

At the Redstone Arsenal, a new line was constructed beginning in March 1945. Line 6 was designed and engineered by Maurice H. Connell & Associates and was intended to be used for the assembly of 81-mm chemical mortars and 155-mm howitzer shells. The site was located on land ceded by Huntsville Arsenal immediately south of the Redstone Arsenal's original boundary. The Tennessee River became the new boundary line for the south side of Redstone. Production on the new line, however,

was not initiated prior to the end of WWII. It was, however, used during the Korean War to produce chemical munitions (Nolte 1998:122-123).

Unlike the other chemical shell lines, Line 6 is much larger, covering almost as many acres as Lines 1 and 2 together. It was quite isolated from the other lines and is built in a slightly triangular shape with the base of the triangle running parallel to the Tennessee River and the apex just off Buxton Road. Like the other chemical lines, relatively few of the buildings were connected by a series of covered ramps. Unfortunately, no area map exists for Line 6, but blueprints do exist for a number of the structures.

The operation of the line is clear. The assembly and packing building (8972), was fed by the propellant weighing and storage building (8975) and an additional shell assembly building (8973). Both of these buildings were serviced by what appears to be a small magazine (8983, a post WWII structure). Also feeding the packing building was Building 8971, another shell assembly structure. Attached to 8972 is Building 8974, a paint storage building. The change house and office (8978) and the boiler house (8977) completed the line.

All of the buildings on Line 6 were constructed of the same materials as the other lines. Structures like the change house and assembly building are large but uncomplicated balloon-framed buildings clad with weatherboards. They feature a varying roofline including gable, hip, and shed. The service magazines are of red, hollow, brick construction tiles. Every building that handled the shells in some way featured blow-out construction in walls and roofs.

The line has suffered much alteration. The ramps have been removed and many of the buildings have been drastically changed to accommodate high tech weapons testing. Buildings 8971, 8972, and 8978 were destroyed in 1996, 1997, and 1999 respectively.

**Recommendation:** This line was not constructed until 1945 and never put into use during WWII and has faced serious alterations. Although the structures were used during the Korean War, they have no WWII association and therefore, are not considered eligible to the NRHP under the WWII context.

**ALSHPO comments:** The ALSHPO concurred per letter dated May 18, 2001 that buildings 8974, 8975, and 8977 are not eligible to the NRHP under the WWII context. Buildings 8971, 8972, and 8978 were demolished in 1996, 1997, and 1998 respectively. The ALSHPO concurred that Building 8973 is not eligible to the NRHP under the WWII context per letter dated August 15, 2000.



## VIII. GULF CHEMICAL WARFARE DEPOT

### GULF CHEMICAL WARFARE DEPOT HISTORICAL BACKGROUND

During the Protective Mobilization, the CWS was assigned new logistical responsibilities that led to major changes in storage facilities. The principal problems arose in 1941 over the storage of chemical materiel and gas masks. The creation of mass quantities of incendiary bombs, which required special handling, further exacerbated the problems. The CWS was faced with delicate storage problems on an unprecedented level. Due to the volatile nature of the bombs and shells, they could not be housed in urban warehouses and there was no remaining space available at Edgewood Arsenal. As early as the winter of 1940-1941, the CWS leased warehouse space in Chicago and Indianapolis for the storage of items delivered by contractors.

The need for new depots was obvious. It seemed logical to build such a facility in tandem with the recently established Huntsville Arsenal and by September 1941, construction plans were underway for the Huntsville Chemical Warfare Depot. Though administratively part of the CWS, the depot was to be activated as a separate post. It, however, shared the same commander as the Huntsville Arsenal, Rollo Ditto, who engaged Lt. William C. Behrenberg to oversee construction and operation of the new depot. Behrenberg became the Executive Officer when the Depot was activated on March 6, 1942. Huntsville Arsenal provided service and support for civilian personnel recruiting and processing, security, safety, public relations, utilities, maintenance and repair. The GCWD, however, trained its own civilians (Joiner 1966).

Initially, 282,000 square feet of toxic gas storage yard was to be constructed, but in November the U. S. Army informed CWS that funds would also be made available to provide storage for 40,000,000 four-pound incendiary bombs. Huntsville Depot was to have half of the magazines needed to fulfill this requirement. The remainder was to go to the other proposed depot in Pine Bluff, Arkansas. By the beginning of the war, CWS had also taken steps to provide itself with a far west depot at Tooele County, Utah (the Desert Warfare Depot). By 1943, CWS had 23,000,000 square feet of storage space (Brophy et al. 1988, Redstone Arsenal website, [www.redstone.army.mil](http://www.redstone.army.mil)).

The CWS depot system consisted of five branch depots--Eastern (Edgewood), Gulf (Huntsville), Midwest (Pine Bluff), Indianapolis, and Desert (Utah)—as well as five chemical sections of the Army Service forces depots in Atlanta, Memphis, New Cumberland, San Antonio, and Utah. Originally the depots located at CWS arsenals had the same names as the arsenals, but this caused confusion. In July 1943, all the names of the depots were changed; hence Huntsville Chemical Warfare Depot became Gulf Chemical Warfare Depot (GCWD).

The main mission of these depots was to receive, store, and ship CWS materiel coming from all CWS arsenals, procurement districts, and other depots. This included all types of CWS munitions, bulk chemicals, decontaminating apparatuses, and

protective materials. The Chemical Section of the ASF depots generally handled distribution of supplies. GCWD provided general supply support to the Fourth Service Command and ammunition to the Fifth and Sixth Service Commands. It also sent general supplies to the Hampton Roads and Charleston Ports of Embarkation and ammunition to the Charleston and New Orleans Ports of Embarkation (Brophy and Fisher 1959).

The toxic gas yard was the first section of the depot to begin operation in early 1942 with the shipment of 500,000 pounds of mustard gas in 55-gallon drums. Soon thereafter the Depot received shipments of phosgene, carbon tetrachloride, and white phosphorus. Toxic gases were generally stored outside so that air could circulate around them. Incendiary bombs were stored in igloos (Figure 36). Most of the labor was done by hand until mechanical equipment such as fork lifts, tractors and trailers were acquired in July 1943 cutting labor expenses by 20 percent (Joiner 1966; Figure 37).

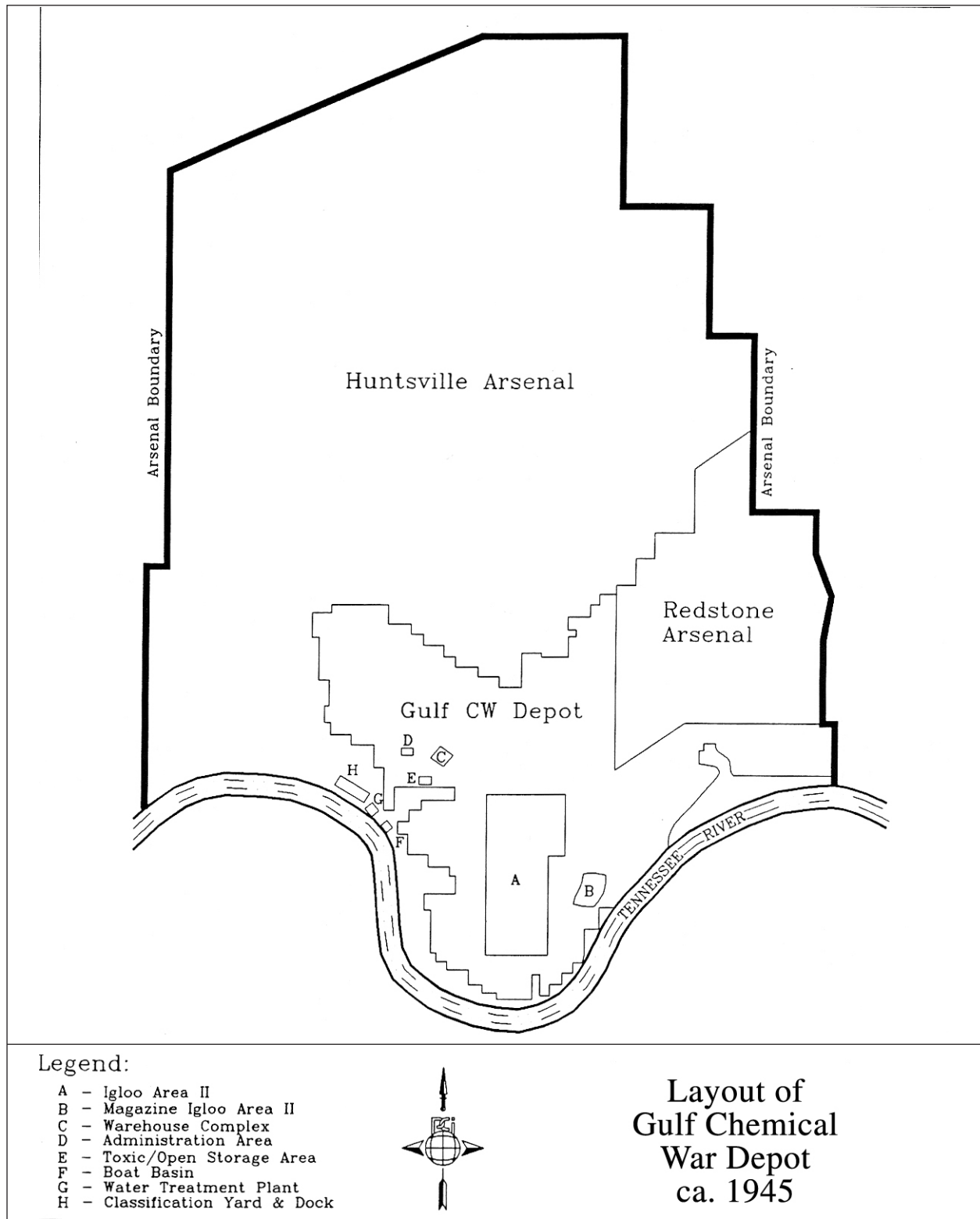
The GCWD was located in the extreme southwestern end of Huntsville Arsenal on approximately 8,000 acres. It covered nearly 12 square miles and had dock facilities on the Tennessee River as well as twelve miles of railroad track. All of its structures were designed by WRS using standard Army plans. No office building was constructed and instead, two pre-Army structures, the Lee Mansion and the Harris House, served as administrative space and quarters. While the Harris House remains, the Lee Mansion was moved off post in 1973. By 1945, the installation had 708,000 square feet of warehouse storage; 624,000 square feet of igloo storage; 868,000 square feet of toxic yard storage and 1,185,000 square feet of open storage. The fledging staff of less than thirty had grown to over six hundred by the end of the war. This was the second largest CWS depot in the U.S., with Desert Warfare Depot being the first (Brophy et al. 1988).

GCWD, renamed Gulf Chemical Depot on August 3, 1946, was abolished on January 15, 1947 and its functions were transferred to Huntsville Arsenal. It became known as GCD Activity on March 26, 1947. The Gulf Chemical Activity was discontinued on September 1, 1948. On that same date, a new Demilitarization, Decontamination, and Destruction Activity was created. The Huntsville Arsenal was placed under the command and control of the Commanding General, Third Army, for participation in the Territorial Command Test (Operation TACT) a month later. Huntsville Arsenal was to have reverted to the Chemical Corps, but remained under the Command of the Third Army until June 30, 1949, when it became a part of Redstone Arsenal (Redstone Arsenal website, [www.redstone.army.mil](http://www.redstone.army.mil)).

## GULF CHEMICAL WARFARE LAYOUT AND REMAINING WWII RESOURCES

For the purposes of this report, buildings and structures in the GCWD have been divided into housing, infrastructure, administration, maintenance and storage uses. The building types remaining at the depot include a few administrative, infrastructure, and maintenance structures that are all similar to their counterparts in the Huntsville

Figure 36  
Layout of Gulf Chemical Warfare Depot, c. 1945



Courtesy of Panamerican Consultants, Inc., 1998



Figure 37  
Photograph of Worker at Gulf Chemical Warfare Depot, c. 1943

Arsenal and the Redstone Arsenal. Storage structures, however, make up the vast majority of the buildings at this installation. There are 381 igloos, seven warehouses, and fifty-three magazines.

Like Redstone Arsenal, GCWD combined the administration area and residential areas into one unit. Unlike the GCWD's sister installations, however, it made use of two preexisting buildings for office space and housing: the Lee Mansion, originally located off Buxton Road and the adjacent Harris House (8012). Because of the critical need for housing in the Huntsville area, many GCWD employees, were also housed in the field office/warehouse (Building 8019) (*Gulf Chemical Warfare Depot*, ca. 1945). The administration area also included a fire station (8014) and a maintenance garage (8017). The fire station was demolished in 2002.

The infrastructure areas are located in the southwestern corner of GCWD. This includes a large sewage plant, dock facilities, and the remainder of a classification yard. This survey did not cover such entities as rail yards, docks, and open storage areas; however, these are easily discernable and played an important role in the history of GCWD.

Storage at GCWD can be divided into four distinct components: igloos for the storage of incendiary bombs and materiel; inert warehouses; above-ground magazines; and open storage yards. The igloos make up the largest single group of buildings at the GCWD and are located at the heart of the post in the bend of the Tennessee River. A 1943 aerial photograph of the area clearly shows a portion of the igloo area characterized by the raw exposed areas of earth. The magazines (standard large and small) are located in the extreme southeastern portion of the installation. The inert warehouses are located north of Buxton Road.

### Administrative Area

These buildings are treated individually below as each has been subject to extensive architectural and historical study.

### Gulf Chemical Warfare Depot—Administrative Area

Table 32. Gulf Chemical Warfare Depot—Administrative Area

Building Number	WWII Use	NRHP Recommendation
8009	CWS Depot Building, DEMOLISHED 1997	Not Eligible
8012	Harris House, Administrative Officers' Quarters	Eligible
8014	Police and Fire Station DEMOLISHED 2002	Not Eligible
8017	Maintenance Garage	Not Eligible

The GCWD administration area is located off Buxton Road near the Shields Road intersection. This administrative area is different from the two sister posts because it

made use of two preexisting buildings, the Lee Mansion and the Harris House (8012), as office space and officer housing.

#### Building 8009 (Demolished)

Building 8009 was an office of brick tile construction that was covered with metal or asbestos siding. It was not unique architecturally or historically.

**Recommendation:** Because of its lack of architectural integrity and historical importance, Building 8009 was recommended as not eligible to the NRHP under the WWII context.

**ALSHPO Comments:** The ALSHPO agreed with this recommendation in a letter of concurrence dated February 20, 1998 and the building has since been demolished.

#### Building 8012

The Harris House is a unique structure on Redstone Arsenal. At first glance, the house appears to be a common Craftsman bungalow dating to the 1920s, but it was actually constructed around an older nineteenth-century structure associated with the adjacent Lee House (Jones 1984). Built in 1818, the Lee House was a two-story, Federal style home that served as the GCWD's headquarters during WWII. The building was moved to another site in Huntsville and restored in 1974.

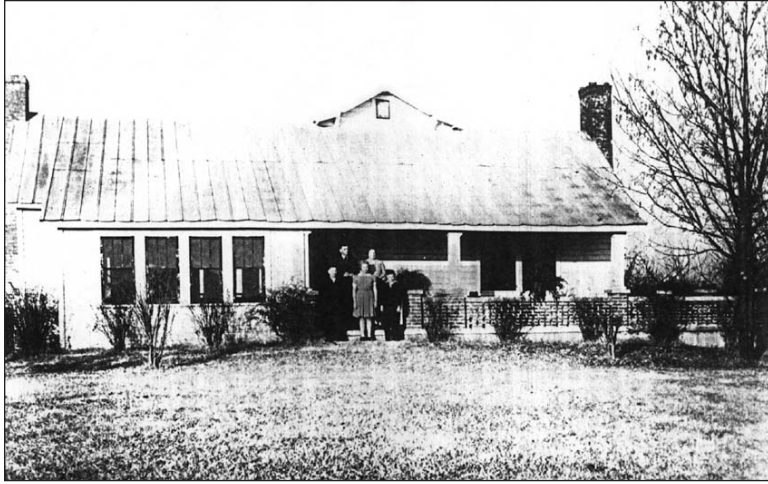
The Harris family purchased the 1,000-acre farm and all buildings in the 1920s and continued to farm. J. B. Harris occupied the "big house", the Lee Mansion, and Sam Harris, Sr., lived in the smaller home 100 yards to the east. Sam Harris, Jr., the son of the last private owner of the house, recalls that his father created the present bungalow by joining two existing old structures, one of them log. Beginning with the log structure, the Harris family converted the buildings to a six-room Craftsman bungalow (Figure 38).

The farm also had a number of other dependencies and buildings, many of which were occupied by share croppers. On the property, the Harrises raised cotton, corn, and a number of truck crops, including cantaloupes. In fact, Sam Harris, Sr., was known as Madison County's "Cantaloupe King." The TVA purchased 200 acres of the farm in the 1930s for \$50.00 per acre, reducing some of the original property.

The Harris House was located in the rural Green Grove Community, which was a part of a larger area known as Pond Beat. This rural agricultural community was typical of those found throughout Madison County in the 1920s. The U. S. Army paid fair market value for the land (\$75.00 per acre).

During WWII, the Lee Mansion was used as office space and the Harris House was used as officers' quarters. After the war, it continued to serve as housing. By the end of the twentieth century, the Army had ceased using the building as housing because of its remote location and the fact that it did not meet the military's standards for modern housing. It did not have central air conditioning and heating, and would





Historic Photograph of the Harris House.



Gulf Chemical Warfare Depot, Harris House.



Gulf Chemical Warfare Depot, Building 8014, Fire Station.



Redstone Arsenal, Building 7012 (Now Demolished).

Figure 38  
Photographs of Buildings 8012, 8014 and 7012



cost too much to renovate. The installation was unsure what it should do about the building since it appeared to have no use to the Army. Many people believed that leaving it vacant but preserving and maintaining it as a piece of Redstone Arsenal's history was "a bad trip from the taxpayer's standpoint" (Peters 1984).

To help them in their dilemma, the Army asked Harvie Jones of Jones & Herrin Architects, MA, to complete a brief examination of the house in 1984. Jones was a natural choice to inspect the structure since he was located in Huntsville, had a national reputation for his historic architectural work, and also had been associated closely with a large number of restoration projects in Huntsville. Jones made a number of observations and recommendations pertaining to the house.

In a letter report of August 25, 1984, on his preliminary examination of the Harris House he summed up his findings in the following paragraphs:

The most likely history of the house is that at least the S. E. Room (with the 19th century chimney) was there in the early days of the adjoining Lee house and most likely was an outbuilding of some sort for the large early 19th century rural planter's house. Since the south-center entry hall floor joists are modern, this may indicate that the hewn floor joists and sash-swan wall framing of the S. W. room was relocated here at some point, or it could only mean that the center-hall joists were replaced due to deterioration. A more thorough examination of the sills in that area could answer this (look for mortise cuts on the hall side of the sills under the hall partitions).

The best one-sentence description of the house would be that it is an early 20th century bungalow-style farmhouse built around the frame of what was probably a small, early 19th century outbuilding of the Lee house.

This house is too attractive, too interesting and too historically important to discard. The best use would be as a residence on its present site. Rather than abandon or demolish it, it would be better to move it as was done with the Lee house. If Redstone has no use for it, consideration should be given to sell to a family for relocation with appropriate restrictions as to its location, restoration and use. Particular care would have to be taken with chimneys since they could not economically be moved intact. Through documentation of the dimensions and appearance (with good close-up photos) and other steps would need to be taken for a good reconstruction of the chimneys and other masonry and concrete elements (as at the bungalow porch).

Since this was a preliminary examination, Jones did not compare the home to other structures in the area. This building may include parts of the only remaining antebellum outbuildings in Madison County.

The house is quite similar to many other Craftsman bungalows in Huntsville, however. In the early twentieth century, the bungalow was one of the most popular house styles in America. They typically feature a side gable roof with wide, overhanging eaves and brackets. The roof usually slopes down in the front to keep the profile low. By the 1920s, the Craftsman bungalow had become the predominant house type in Huntsville and the influence of this style was also evident in large buildings such as Bison School and Green Street YMCA (Jones 1983). Today, many of these

bungalows stand in Huntsville's Old Town Historic District. The Harris House is a good example of the style and was perhaps chosen by the owners because they wished to bring the latest urban style to the county. It was certainly quite different from its associated Lee House.

The residence is now used to house the occasional visiting archaeological field crew and in spite of the Army's indecision as to final disposition of the house, it is still being fairly well maintained.

**Recommendation:** While it is not eligible under the World War II context or the Cold War context, its origins as an antebellum outbuilding are remarkable and may warrant NRHP inclusion on its own. The house is perhaps just as significant because it is the last remnant of a community which existed on Redstone property, before the military arrived. It represents the farms, plantations, and villages that dotted this curve in the Tennessee River prior to 1941. It is isolated in a remote section of the post surrounded by trees and open space which helps to foster its rural association. Because it remains in situ, unaltered, and in good condition, it should be considered individually eligible for the NRHP under Criteria A, C, and possibly Criterion D. The latter is included in this case as there may be intact archaeological remains associated with the nineteenth-century occupation of the building and its later early twentieth-century transformation. A nomination should address the life styles of rural planters and their associated slaves, servants, and tenants from the early nineteenth century until the Army acquired the property.

**ALSHPO comments:** Per letter dated May 18, 2001, the ALSHPO concurred that the Harris House is eligible to the NRHP under Criteria A, C, and possibly D.

### Building 8014

Another important building in the administration area of the GCWD was the police and fire house, Building 8014 (Figure 38). This building was demolished in 2002.

Fortunately a blueprint exists for this structure (Figure 39). The building itself contained three principal sections—a central, two-story office flanked on either side by long garages once used by fire engines and various emergency vehicles. The hipped roof office was clad with simple drop siding and had central, double entrance doors with a transom on the first level with triple, six-over-six sash windows on each side. The second story featured a centered grouping of six sash windows and two small, fixed, square windows on either side of the larger window unit. There was also a gable dormer vent and wide, overhanging eaves in the roof. The flanking sections were one-story with hipped roofs and multiple garage bays. Alterations to the building included extensions to the garage sections were extended and removal of the chimney.

There was another similar building (7012) on post located near the present site of the Goddard House in the former administration area of the Redstone Arsenal. It was

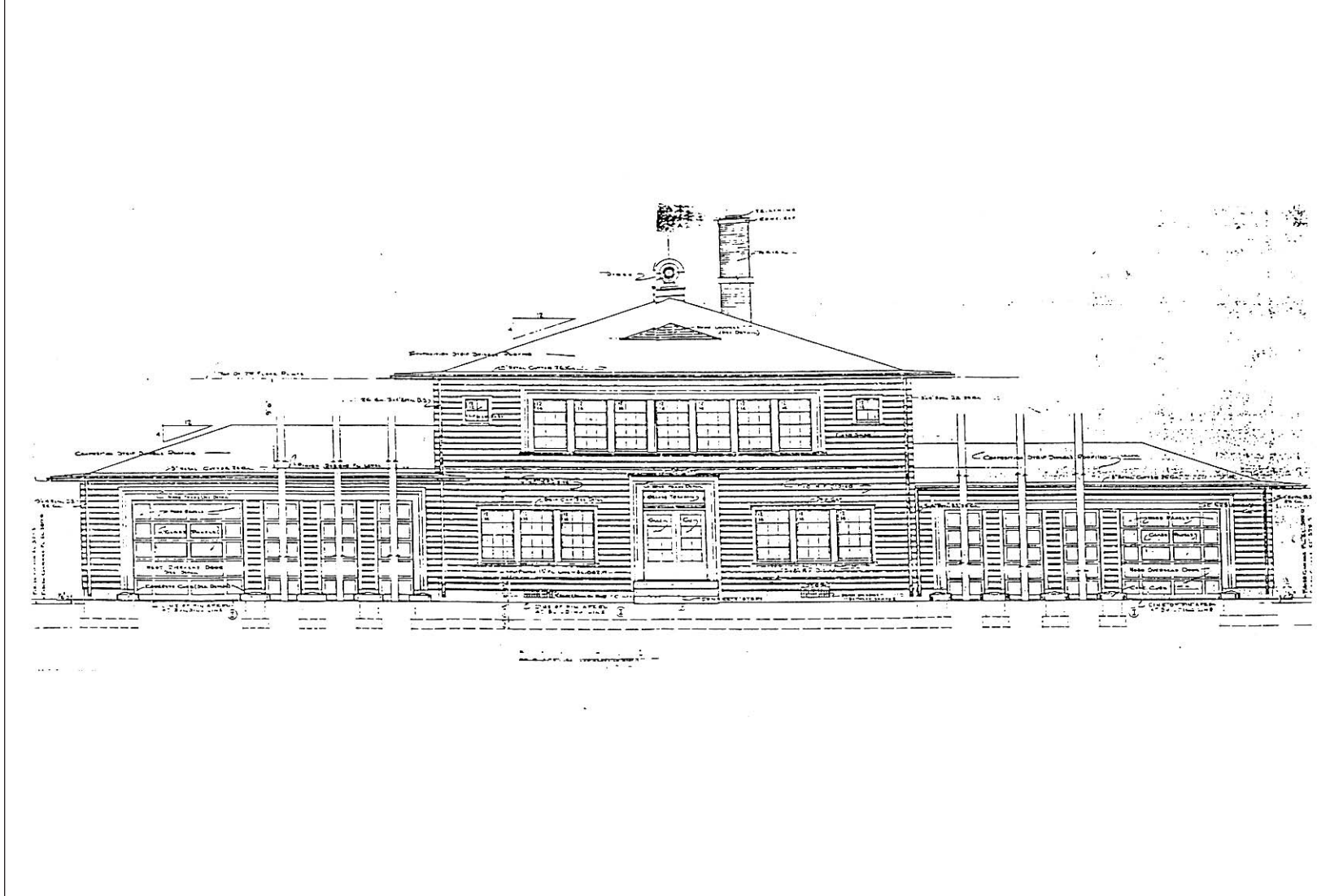


Figure 39  
Blueprint of Building 8014

intentionally burned in 1985 as a fire fighting training exercise. Unlike building 8014, this fire station had a multi-story tower and a curved one-story porch across the entrance bay. It was of similar size and scale and also had a row of small non-sash windows across a portion of the second-story main façade.

Building 8014 was constructed in 1942 to serve as a police and fire station. In the 1950s it also housed a kindergarten and the offices of the Special Services division of the Redstone Arsenal. By 1960 the building was also used for the Redstone Yacht Club. The building officially ceased its function as a fire station in December 1974 (Redstone Arsenal Command Historian Office, historical files).

**Recommendation:** While it is clear that this building holds some architectural merit, it is not considered eligible to the NRHP for its architecture. The fact that there were two of these suggests that this was a standard building plan. It is a property with some interesting features that make it more aesthetically pleasing than the multitude of other industrial and military buildings on this installation, but if placed outside of the Redstone Arsenal, it would not be considered eligible. It is not associated with any district or group of buildings, and it is situated in a remote location far from any of the key production lines which made this facility important during WWII. Given this, it is not considered a significant building under the WWII context. Before any alterations, including demolition, occur, it is that recommended that the building be documented with 35-mm black and white photography of all elevations and its overall setting.

**ALSHPO comments:** Per letter dated May 18, 2001, the ALSHPO concurred that the fire station is not eligible to the NRHP and should be documented with photography prior to any alterations. It was subsequently demolished in 2002.

### Building 8017

Building 8017 is a maintenance garage now clad with modern siding. It is not unique architecturally or historically.

**Recommendation:** Building 8017 lacks historical significance under the World War II context given its function and alterations. It is not recommended as eligible to the NRHP.

**ALSHPO comments:** The ALSHPO concurred that this building is not eligible to the NRHP under the WWII context per a letter dated August 15, 2000.

## **Gulf Chemical Warfare Depot—Inert Warehouse Area**

Table 33. Gulf Chemical Warfare Depot—Inert Warehouse Area

<b>Building Number</b>	<b>WWII Use</b>	<b>NRHP Recommendation</b>
8019	Office, DEMOLISHED 1997	Not Eligible
8020	Change House, DEMOLISHED 1999	Not Eligible
8021	Warehouse	Not Eligible
8022	Warehouse	Not Eligible
8023	Warehouse	Not Eligible

8024	Warehouse	Not Eligible
8025	Warehouse	Not Eligible
8026	Warehouse	Not Eligible
8027	Warehouse	Not Eligible

Originally, GCWD had two large warehouse areas; however, only these inert warehouses remain. The second area was located on what is now a series of firing ranges and has since been completely demolished. This inert warehouse area is located north of the igloos and directly behind the Harris House (8012). They are more or less unchanged and are still being used for storage purposes. In this group is also a standard change house (8019) of wooden clapboards and a field office (8020). The field office had a hipped roof and, for a number of years, actually served as a barracks for men working at GCWD. Building 8027 was damaged by a storm in 2002 and there are plans to demolish the structure because the damage was too great to restore.

The seven remaining warehouses in this area are built on concrete foundations with tile load-bearing walls and a side-gabled roofs punctuated by vents. They are typical of warehouses across the three posts, except for their immense size. These rectangular buildings are 183 ft. wide and 605 ft. long. By contrast, the warehouses on Redstone Arsenal are generally about 51 ft. wide and 240 ft. long. It is staggering to envision the amount of hard labor involved in inventorying and transporting supplies in these buildings without the use of forklifts—a convenience not instituted until July 1943.

Although it is outside of the scope of work of this report, it should be noted that these warehouses now store original Redstone rockets along with other rockets and missiles designated as historic property. Certainly, the role of these warehouses during the Cold War should be further researched.

**Recommendation:** These resources do not appear to be eligible to the NRHP under the WWII context as they are not architecturally distinctive nor did they play the most integral role at the depot.

**ALSHPO comments:** The ALSHPO concurred that buildings 8019 and 8020 are not eligible for nomination to the NRHP and cleared for demolition by letter of concurrence dated February 20, 1998. An additional letter dated May 18, 2001, concurred that buildings 8021, 8022, 8023, 8024, 8025, 8026, and 8027 are also not eligible to the NRHP under the WWII context.

### Gulf Chemical Warfare Depot—Infrastructure: Water System

Table 34. Gulf Chemical Warfare Depot—Infrastructure: Water System

Building Number	WWII Use	NRHP Recommendation
8038	Filter Building, Water Treatment Plant	Not Eligible
8039	Low Lift Pump Station	Not Eligible
T8040	Tank Shed	Not Eligible
8041	Unknown Water Treatment Plant Building	Not Eligible
8042	Unknown Water Treatment Plant Building	Not Eligible

All of these buildings are located along the Tennessee River and served as water treatment buildings. Buildings 8038 and 8039 are very similar and constructed of concrete with flat roofs. The unknown buildings (8041 and 8042) are smaller, concrete structures. The tank shed (T8040) is a raised frame structure.

The buildings are adjacent to the only docks at Redstone Arsenal. During the late 1950s a large boat basin was constructed beside the water treatment plant. From this boat basin, Saturn rocket components were shipped. The actual dock area is still intact and is abutted by the railroad classification yard

**Recommendation:** Although unchanged since their construction, none of these support buildings are architecturally distinctive or served an integral role during World War II. Given this, the water system buildings are not considered eligible to the NRHP under the World War II context.

**ALSHPO comments:** Per letter of concurrence dated May 18, 2001, the ALSHPO agreed that these buildings are not eligible to the NRHP under the WWII context.

### Gulf Chemical Warfare Depot—Igloo Area 2

Table 35. Gulf Chemical Warfare Depot—Igloo Area 2

Building Number	WWII Use	NRHP Recommendation
8101-8125	Igloo 81 ft. (25 Units)	Eligible
8131	Igloo 81 ft.	Eligible
8205	Igloo 81 ft.	Eligible
8208-8214	Igloo 81 ft. (7 Units)	Eligible
8216-8231	Igloo 81 ft. (16 Units)	Eligible
8301-8315	Igloo 81 ft. (15 Units)	Eligible
8317-8331	Igloo 81 ft. (15 Units)	Eligible
8333-8375	Igloo 81 ft. (43 Units)	Eligible
8377-8389	Igloo 81 ft. (13 Units)	Eligible
8401-8408	Igloo 81 ft. (8 Units)	Eligible
8501-8506	Igloo 81 ft. (6 Units)	Eligible
8507-8508	Igloo 81 ft. (2 Units)	Eligible
8511-8513	Igloo 81 ft. (3 Units)	Eligible
8516	Igloo 81 ft.	Eligible
8519-8539	Igloo 81 ft. (21 Units)	Eligible
8541-8548	Igloo 81 ft. (8 Units)	Eligible
8553-8556	Igloo 81 ft. (4 Units)	Eligible
8558-8559	Igloo 81 ft. (2 Units)	Eligible
8561-8563	Igloo 81 ft. (3 Units)	Eligible
8565	Igloo 81 ft.	Eligible
8569	Igloo 81 ft.	Eligible
8572	Igloo 81 ft.	Eligible
8574-8575	Igloo 81 ft. (2 Units)	Eligible
8600	Magazine	Eligible
8601-8644	Igloo 81 ft. (44 Units)	Eligible
8646-8647	Igloo 81 ft. (2 Units)	Eligible
8650-8652	Igloo 81 ft. (3 Units)	Eligible
8700	Magazine	Eligible

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8701-8715	Igloo 81 ft. (15 Units)	Eligible
8717-8727	Igloo 81 ft. (11 Units)	Eligible
8729-8735	Igloo 81 ft. (7 Units)	Eligible
8737-8761	Igloo 81 ft. (25 Units)	Eligible
8785	CWS Packing, Shipping, and Receiving Building	Not Eligible
8786	Boiler House	Not Eligible
8856-8869	Igloo 81 ft. (14 Units)	Eligible
8901-8902	Igloo 81 ft. (2 Units)	Eligible
8904-8926	Igloo 81 ft. (23 Units)	Eligible
8931-8934	Igloo 81 ft. (4 Units)	Eligible
8936-8949	Igloo 81 ft. (14 Units)	Eligible
8950-8967	Igloo 81 ft. (18 Units)	Eligible

Igloos were first developed after a tragic incident at the Lake Denmark Ammunition Depot in New Jersey in 1926 when lightning hit a hollow tile magazine causing an explosion. Flying debris ignited the surrounding magazines and everything within a 3,000-foot radius was destroyed as were areas of the neighboring Picatinny Arsenal. Nineteen people were killed and many were wounded, including civilians living in the surrounding densely populated area. The property damage was extraordinary (Reed 1995:41). Military industrial designers were alarmed and called for changes in weapon storage facilities. Army and Navy officials recommended that high explosive magazines be covered with earth to prevent such destruction.

Antecedents of the World War II igloo were constructed at various locations including the Army depots at Savanna, Illinois; Aberdeen, Delaware; Benicia, California and at the Navy's Yorktown Naval Mine Depot by 1929 (Thomson and Mayo 1991:361). These semi-cylindrical magazines were made of reinforced concrete covered with earth except on their end walls that were protected by barricades of earth faced with creosoted wood. They were essentially sunk into the ground which would theoretically direct an explosive force up instead of horizontally. Constructed in groups of seven with 500 feet separating them and 1,900 feet between each group, these structures were forty feet long and ten feet high at their arch crown and held 140,000 pounds of explosives. They were also protected by a lightning protection system which electronically connected all the reinforcing steel and other metal parts to a copper girdle that encircled the whole structure and was embedded in its footing (Reed 1995:43).

This building form proved to be successful and by 1941 igloos were required in all future depot construction. As soon as the igloo design was instituted, it was modified to suit different storage needs and budgetary concerns. They ranged in size from forty to eighty feet and were typically twenty-six feet wide and thirteen feet high. The Ordnance Department primarily used the 60-footer, but a few of the 80-foot examples were also constructed (Thomson and Mayo 1991:368). The Army constructed sixteen new ordnance depots for use during World War II and all employed permanent igloos for storage (Thomson and Mayo 1991:377). Umatilla, Oregon, for example, had over 750 igloos (Thomson and Mayo 1991:368).

In the case of the CWS, igloos were primarily used for incendiary bombs. The building used by the Ordnance Department for the storage of smokeless powder became the prototype for the CWS igloos. The CWS igloos were 29 x 82 feet, which were twice the length of the prototype igloos constructed at Edgewood. These igloos



were capable of storing 58,500 four-pound incendiary bombs in 2,200 square feet. There was a standard 300 foot gap between each igloo (Brophy et al. 1988:390), although the distance needed depended upon the amount of explosives stored and the location of other surrounding buildings (Reed 1995:58). Igloos were built at all five of the CWS depots.

The igloo area at GCWD was located at the extreme southern end of the post in a bend in the Tennessee River. A letter of authorization dated December 17, 1941, called for the construction of 200 concrete igloos, 26 feet 6 inches wide, 81 feet long, and 12 feet 9 inches from the floor to arch crown, at the cost of \$2,520,000 or \$12,600 per igloo. In accordance with specifications, the igloos were spaced approximately 300 feet apart. Igloo storage equipment and installation were authorized at \$52,500. Midwest Construction Company, a subcontractor of Kershaw Butler Engineers Ltd, constructed the igloos. By the time all the igloos were completed, GCWD had approximately 386 igloos, the most of any of the five CWS depots (*Gulf Chemical Warfare Depot* ca. 1945 , Brophy et al 1988:383).

Incendiary bomb clusters arrived by rail and truck. They were manhandled onto conveyor belts that led into the igloos and then stacked inside by hand, a procedure that continued for almost a year before the use of forklifts and pallets became general practice. A number of loading devices were added to aid in the handling of extremely heavy loads. These included crane-operated booms and jigs that could lift a standard load of seven 500-pound M17 clusters (Brophy et al. 1988). These mechanisms can be seen on several different igloos at GCWD (Figures 40 and 41).

An *Engineering News-Record* article from 1941 documents the construction methods used to build a typical igloo at the Anniston Ordnance Depot, which was possibly the same method employed at the GCWD (Figure 40). Machines excavated each igloo site and then concrete was brought by truck and distributed by wheelbarrow. Once the floor was complete, the arch was constructed. First, quarter circles of Armco heavy duty corrugated tunnel liner plate were put into place. The exterior of the plates were covered with a skin sheet to provide a smooth surface for easy concrete adhesion. Forty-three sets of steel forms were used in a standard igloo. The concrete was placed between the tunnel plates and an outside form which consisted of three foot wide panels set in place on the arch and held by quick fastening wedge bolts between 18 inch plates. The concrete for the arch end was placed in sections by cranes. After the concrete was in place, the completed igloo was then waterproofed and covered with earth (Reed 1995:50). For the most part, igloo end walls consisted of steel-reinforced concrete walls rising into triangular parapets that are sometimes clipped at the top as in the Area II igloos. In some examples, end walls of timbers or railroad ties were clad with stucco. All end walls projected past the roofline creating a parapet, which also echoed the construction blast walls in ordnance production buildings. The igloos at GCWD also have door variations. Some have single or double hinged doors while others are fitted with sliding doors (McCroskey 2002a).

The igloos remaining at the Redstone Arsenal are in various states of repair. Many are covered with kudzu and almost invisible. Others are well maintained and are still being used to store weapons. All 386 igloos are situated in the southernmost section of the installation along a bend of the Tennessee River.

Figure 40  
Blueprint of Igloo and Photograph of Building 8931

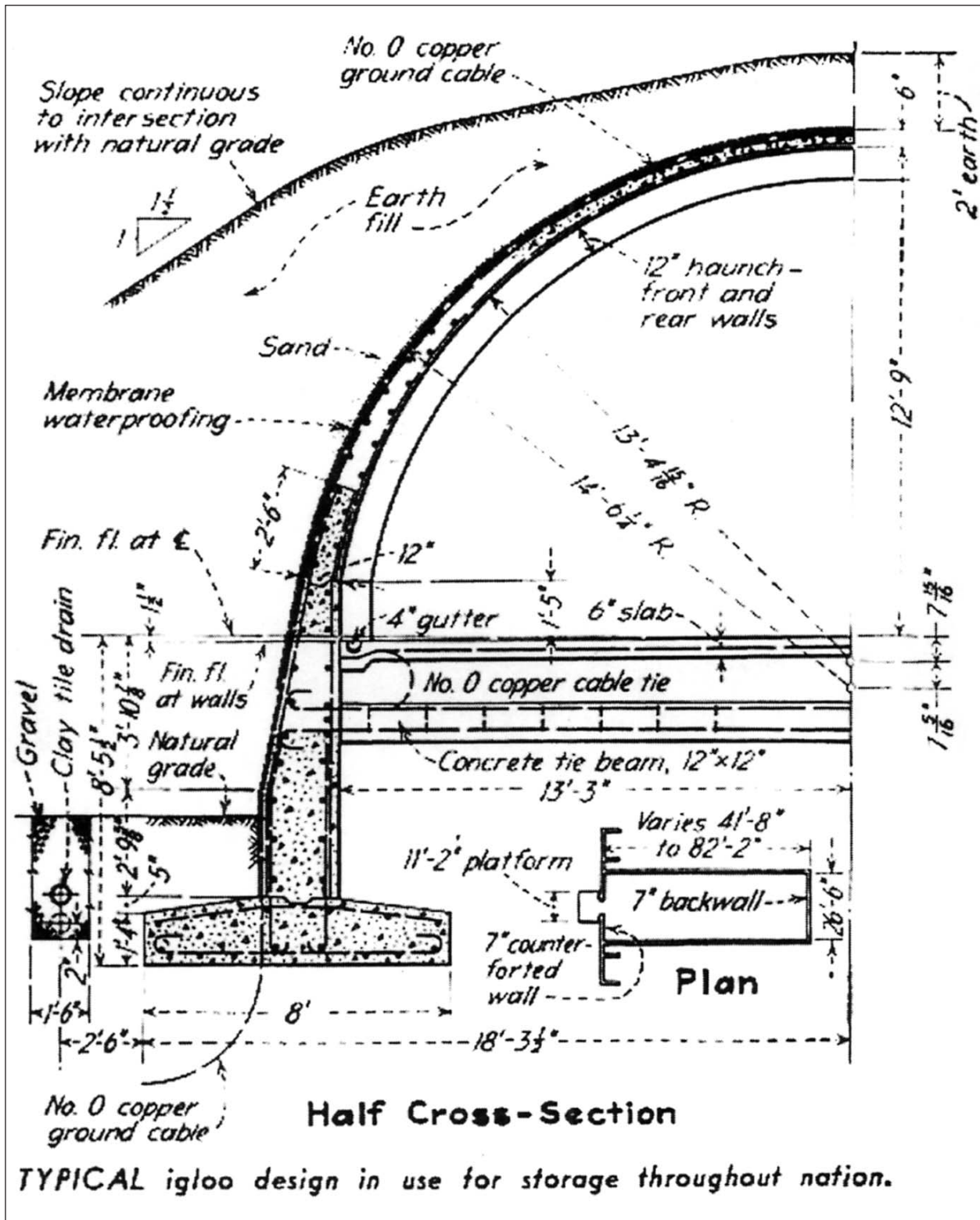


Figure 41  
Photographs of Building 8913 and 8869



A. 1996 photograph of igloo, Building 8913, showing crane system, GCWD (Panamerican Consultants, Inc., 1998).



B. 1996 photograph of igloo, Building 8869, showing crane system, GCWD (Panamerican Consultants, Inc., 1998).



While igloos are the main bulk of the buildings in the igloo area, there are four other structures. Two are standard magazines (8600, 8700); one is a packing, shipping, and receiving building (8785); and the last is the GCWD 's original boiler house (8786). They are replicas of similar buildings found on Huntsville and Redstone Arsenals.

**Recommendation:** The sheer numbers of igloos make them, by far, the most common structure at the entire Redstone Arsenal. They served an important purpose during World War II and represent the primary mission of the GCWD. They were built expressly to serve the chemical weapons production at the arsenals to the north and were an affirmation of the enormous chemical weapons output that took place there. While it is not an uncommon building form in the history of military architecture, they are unique in their construction and purpose. This was a building form which was perfected and standardized during the war and should not be overlooked. It is for these reasons that all of the igloos in Igloo Area 2 of the Gulf Chemical Warfare Depot are recommended eligible to the NRHP as a district under Criteria A and C under the World War II context.

To save the Directorate of Environmental Management from coordinating with ALSHPO for all upgrade or maintenance projects on individual igloos, it is recommended that each igloo type be documented with photographs and drawings and that a row of igloos remain preserved in their original form.

**ALSHPO comments:** The ALSHPO concurred with this recommendation per letter dated May 18, 2001 to the Redstone Arsenal's Directorate of Environmental Management.

### Gulf Chemical Warfare Depot—Igloo Area 2: Magazines

Table 36. Gulf Chemical Warfare Depot—Igloo Area 2: Magazines

Building Number	WWII Use	NRHP Recommendation
8801-8820	Standard Design: Large Magazines (20 units)	Not Eligible
8821-8822	Standard Design: Small Magazines (2 units)	Not Eligible
8824-8827	Standard Design: Small Magazines (4 units)	Not Eligible
8829-8830	Standard Design: Small Magazines (2 units)	Not Eligible
8833-8855	Standard Design: Small Magazines (23 units)	Not Eligible

These large and small magazines are of standard military design. Both types are side gabled with roof vents and have concrete foundations with load bearing construction tile walls. The larger structures seem to be made of a different type of construction tiles and appear to be much smaller in size than the typical 8-inch square tiles. It is not known why the tiles are different. The only door to the storage buildings is a typical flush hinged door. The magazines do not seem to have had extensive rail or road connections.

It can be assumed that these structures housed finished ammunition of some type since similar structures on Redstone and Huntsville Arsenals were used in that way. This is, however, a far larger collection of magazines than is seen on the other posts.

These magazines are in a very isolated section of the post and can be reached only through the use of a four-wheel drive vehicle. They are completely derelict and are no longer being used by the Army. They do not show up on current Redstone Arsenal maps. All the structures are missing their doors and some appear to be storing rock core samples.

**Recommendation:** Given the scarcity of data on the use of these buildings and their condition, this group of buildings was recommended not eligible to the NRHP under the WWII context.

**ALSHPO comments:** Per letter of concurrence dated May 18, 2001, the ALSHPO agreed that these magazines are not eligible to the NRHP.

## IX. CONCLUSIONS AND RECOMMENDATIONS

This document is a combination of the 1998 Panamerican, Inc. report titled, *Architectural Assessment of the World War II Military and Civilian Works, U.S. Army Aviation and Missile Command, Redstone Arsenal, Madison County, Alabama* (Nolte 1998) and the 2001 New South Associates, Inc., *Redstone Arsenal World War II Resource Study* (Langdale 2001). The purpose of this report is to present a comprehensive WWII historical and architectural context for the Redstone Arsenal and list the definitive recommendations of NRHP eligibility.

At the end of this report in Appendix A is a table of all of the World War II buildings and structures at the Redstone Arsenal. Appendix A lists their current and historic name/function; the historic installation association (Huntsville Arsenal, Redstone Arsenal or Gulf Chemical Warfare Depot) and building type; its date of construction; condition (good, fair, poor, or demolished); level of integrity (altered, unaltered, or moved); and eligibility status for the NRHP. For those buildings recommended eligible, the criterion under which it qualifies and the context or theme that applies is also included. Appendix B is a list of all buildings at the Redstone Arsenal recommended as eligible to the NRHP, including those that are eligible only under the Cold War context. Appendix C contains the ALSHPO concurrence letters received by DEM.

There were five historic districts along with one individual building recommended eligible to the NRHP under the World War II context as a result of this survey reassessment. The ALSHPO has concurred with these recommendations. They are summarized below. Taken as a whole, the historic properties illustrate the history of the Arsenal from the pre-federal period through WWII as well as the complete process of weapons production. The mustard gas and carbonyl iron buildings show the first steps in the manufacture of chemical weapons and materials while the ordnance plant production line illustrates the final assembly and product.

Table 37. Proposed Carbonyl Iron Unit Historic District

Building Number	WWII Use	NRHP Recommendation
5561	Carbonyl Iron Unit, ICY Towers	Eligible
5562	Compressor	Eligible
5563	Decomposition Building	Eligible
5564	Hydrogen Building	Eligible
5565	Office Building and Labs	Eligible
5566	Iron Preparation Building	Eligible
5567	Carbon Monoxide Generating Building	Eligible
5572	Carbon Monoxide Generating Building	Eligible

The carbonyl iron unit is eligible as a NRHP district under Criteria A and C. Because it was constructed as a standby plant in case the only remaining facility in New Jersey was destroyed, this facility operated for only four months in 1943. The buildings and equipment, however, were obviously constructed during that period and still

remain with few, if any, alterations—a rarity on this installation. Carbonyl iron was a necessary component in radar and radio equipment. It was used in the war effort and unlike the toxic gases, it was actually employed in combat. The district is eligible under Criterion C because it is an example of a manufacturing process, which requires nearly one of a kind structures and buildings. Only three of these plants exist in the world. The district is easy to define as is set apart from the remainder of Plant Area 2 with no modern intrusions (see Figure 9). It should include all of the buildings listed above.

Table 38. Proposed Mustard Gas Historic District

<b>Building Number</b>	<b>WWII Use</b>	<b>NRHP Recommendation</b>
5661	H Reactor Unit	Eligible
5662	Sulfur Monochloride Building	Eligible
5663	Ethylene Generator Building	Eligible
5664	(Tail) Gas Scrubber	Non-Contributing/Not Eligible
5666	HS Scrubber and Disposal Reactor	Eligible
5668	Chlorine Warehouse	Eligible
5669	Chlorine Warehouse	Eligible
5670	Chlorine Warehouse	Eligible
5671	H Reactor Building	Eligible
5672	Sulfur Monochloride Building	Eligible
5673	Ethylene Generator Building	Eligible

The mustard gas buildings in Plant Area 2 are eligible to the NRHP as a district under Criteria A and C. They represent an important manufacturing process which was once evident at six different facilities within the Arsenal, but now only the two facilities in Plant Area 2 remain. Unlike other production lines in Plant Areas 1 and 2, the exterior of these buildings is still intact and unaltered. They also include each of the structures necessary to create a complete mustard gas manufacturing line. Blueprints show that each mustard gas plant consisted of a sulfur monochloride building (5662 and 5672), an ethylene generator building (5663 and 5673), an H reactor building (5661 and 5671), two 50,000 cubic foot capacity gas holders, a tail gas scrubber building (5664), a disposal reactor (5666), a lunch room, and several accessory structures like warehouses (5668, 5669, and 5670). Aside from the gas holders and the lunch room, there are examples of each of these buildings in Plant Area 2. Although mustard gas was not used in combat, it was the most important of the toxic gases stockpiled and was a principle product of the Huntsville Arsenal during World War II.

These buildings are also contiguous, unlike the other plant areas, and there are no non-historic building intrusions within the group, making the boundaries of a historic district easy to define (see Figure 12). The district should include all of these buildings with 5664 remaining non-contributing because of its loss of integrity.

Table 39. Proposed Redstone Arsenal Line 3 Historic District

<b>Building Number</b>	<b>WWII Use</b>	<b>NRHP Recommendation</b>
7529	Elevated Service Magazine	Eligible



7530	Elevated Service Magazine	Eligible
7531	Elevated Service Magazine	Eligible
7551	Chemical Shell Receiving Building	Eligible
7551a	Chemical Shell Receiving Building	Eligible
7552	Standard Service Magazine	Eligible
7553	Assembly, Packing, and Shipping Building	Eligible
7554	Assembly, Packing, and Shipping Building	Eligible
7555	Propellant Charge Building DEMOLISHED 2001	Not Eligible
7556	Primer Service Building	Eligible
7557	Men's Locker Room	Eligible
7558	Powder Service Building/Office	Eligible
T7561	Locker Rooms and Change House, DEMOLISHED 1998	Not Eligible
7565	Unknown Industrial Building DEMOLISHED 2002	Not Eligible
7567	Unknown Industrial Building	Eligible
7569	Remelt Munitions Building, DEMOLISHED 1998	Not Eligible
7585	Unknown Industrial Building	Eligible
7587	Unknown Industrial Building	Eligible

The buildings on the former Redstone Arsenal Plant Line 3 are eligible to the NRHP as a district under Criteria A and C. Line 3 manufactured 105-mm chemical shells beginning in April 1942. Later in 1944, this line was also used for paint storage and to reprocess ammunition returned from overseas.

The buildings remaining from this line are intact and have suffered few changes. They illustrate the production facilities and function of the Redstone Arsenal. Criterion C can also be employed here because the buildings on the line embody a distinctive method of construction unique to the manufacture of chemical weapon shells.

Table 40. Proposed Gulf Chemical Warfare Depot Igloo Area 2 Historic District

Building Number	WWII Use	NRHP Recommendation
8101-8125	Igloo 81 ft. (25 Units)	Eligible
8131	Igloo 81 ft.	Eligible
8205	Igloo 81 ft.	Eligible
8208-8214	Igloo 81 ft. (7 Units)	Eligible
8216-8231	Igloo 81 ft. (16 Units)	Eligible
8301-8315	Igloo 81 ft. (15 Units)	Eligible
8317-8331	Igloo 81 ft. (15 Units)	Eligible
8333-8375	Igloo 81 ft. (43 Units)	Eligible
8377-8389	Igloo 81 ft. (13 Units)	Eligible
8401-8408	Igloo 81 ft. (8 Units)	Eligible
8501-8506	Igloo 81 ft. (6 Units)	Eligible
8507-8508	Igloo 81 ft. (2 Units)	Eligible
8511-8513	Igloo 81 ft. (3 Units)	Eligible
8516	Igloo 81 ft.	Eligible
8519-8539	Igloo 81 ft. (21 Units)	Eligible
8541-8548	Igloo 81 ft. (8 Units)	Eligible
8553-8556	Igloo 81 ft. (4 Units)	Eligible
8558-8559	Igloo 81 ft. (2 Units)	Eligible
8561-8563	Igloo 81 ft. (3 Units)	Eligible
8565	Igloo 81 ft.	Eligible

8569	Igloo 81 ft.	Eligible
8572	Igloo 81 ft.	Eligible
8574-8575	Igloo 81 ft. (2 Units)	Eligible
8600	Magazine	Eligible
8601-8644	Igloo 81 ft. (44 Units)	Eligible
8646-8647	Igloo 81 ft. (2 Units)	Eligible
8650-8652	Igloo 81 ft. (3 Units)	Eligible
8700	Magazine	Eligible
8701-8715	Igloo 81 ft. (15 Units)	Eligible
8717-8727	Igloo 81 ft. (11 Units)	Eligible
8729-8735	Igloo 81 ft. (7 Units)	Eligible
8737-8761	Igloo 81 ft. (25 Units)	Eligible
8785	CWS Packing, Shipping, and Receiving Building	Not Eligible
8786	Boiler House	Not Eligible
8856-8869	Igloo 81 ft. (14 Units)	Eligible
8901-8902	Igloo 81 ft. (2 Units)	Eligible
8904-8926	Igloo 81 ft. (23 Units)	Eligible
8931-8934	Igloo 81 ft. (4 Units)	Eligible
8936-8949	Igloo 81 ft. (14 Units)	Eligible
8950-8967	Igloo 81 ft. (18 Units)	Eligible

All of the igloos are eligible to the NRHP as a district under Criteria A and C. Their sheer numbers, 381, make them, by far, the most common structure on the entire Redstone Arsenal. They served primarily as storage units for incendiary bombs and other explosive materials during World War II and represent the primary mission of the GCWD. While it is not an uncommon building form on military installations, they are unique in their construction and purpose.

ALSHPO concurrence potentially means that mitigation would be necessary every time changes, upgrades, or maintenance be undertaken on any of the 386 igloos. To avoid such time consuming technicalities, we recommend that the DEM document one of each type of igloo with photographs and drawings and select a small number of the igloos to be preserved in their original form. The igloos to be left unaltered should ideally be grouped together in a row so as to illustrate their original setting and relationship to one another. The ALSHPO agreed to this proposal in a meeting at RSA on August 15, 2002. An MOA is being prepared.

Table 41. Proposed Redstone Arsenal Line 2 Historic District

<b>Building Number</b>	<b>WWII Use</b>	<b>NRHP Recommendation</b>
7721	Explosives Magazine, DEMOLISHED 1998	Not Eligible
7722	Tetryl Screening and Blending Building	Eligible
7722a	Unknown Industrial Building	Eligible
7723	Service Magazine and Rest House, DEMOLISHED 2000	Not Eligible
7724	Tetryl Pelleting Building	Eligible
7724a	Service Magazine	Eligible
7724b	Unknown Industrial Building	Eligible
7725	Service Magazine and Rest House, DEMOLISHED 2000	Not Eligible
7726	Pellet and Pour House, DEMOLISHED 1998	Not Eligible
7726a 1 & 2	Walkway to Pellet and Pour House, DEMOLISHED	Not Eligible

	1998	
7726a-3	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7726b	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7726c	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7726d	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7726e	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7726f	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7727	Packing and Shipping	Eligible
7728	Change House and Bomb Proof House, DEMOLISHED 1998	Not Eligible
7729	Boiler House, DEMOLISHED 1998	Not Eligible
7729a	Walkway, DEMOLISHED 1998	Not Eligible
7734	Unknown Industrial Building, DEMOLISHED 1998	Not Eligible
7735	Vacuum Pump House, DEMOLISHED 1998	Not Eligible
T7737	Unknown Industrial Building	Eligible
7738	Tetryl Screening Building, DEMOLISHED 1998	Not Eligible
7739	TNT Screening Building, DEMOLISHED 1998	Not Eligible

The remaining contributing buildings on Redstone Arsenal Line 2 illustrate the process of burster charge production during World War II and are recommended as eligible to the NRHP under Criteria A and C. Although most of the structures have been demolished, DEM should continue to consult with ALSHPO for the proper mitigation path in the case of further alterations and demolition. Should changes be proposed, the remaining buildings within this NRHP eligible historic district should be documented in the same manner as the others prior to alterations. Such documentation should aim toward a full explanation of the process of burster charge manufacture.

Table 42. Proposed Harris House NRHP Property

Building Number	WWII Use	NRHP Recommendation
8012	Harris House, Administrative Officers' Quarters	Eligible

Finally, the Harris House (8012) is considered eligible to the NRHP as an individual building under Criteria A, C, and D but not under the World War II context. The building actually began as an antebellum outbuilding of the Lee Mansion which once stood to the west of the Harris House. In the 1920s, it was remodeled into a bungalow. Its unique architectural history makes it eligible under Criterion C. The house is perhaps more significant because it is the last remnant of life here before the military arrived, and is hence eligible under Criterion A. It represents the farms, plantations, and villages that once dotted this curve in the Tennessee River prior to 1941. Because of this association, its period of significance dates from the mid-nineteenth century to 1941 when the military arrived. It is isolated in a remote section of the post surrounded by trees and open space, which helps foster its rural association. It remains in situ, unaltered, and in good condition. It also may have the potential for intact associated archaeological deposits, thus it may also be eligible under Criterion D. There have been discussions about moving the house to save it from demolition by the Army. It is recommended that the building stay in its location so as to not jeopardize its NRHP status.

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## APPENDIX A – REDSTONE ARSENAL WWII HISTORIC RESOURCES



## REDSTONE ARSENAL WWII HISTORIC RESOURCES

Building Number	Current Name/Use	Historic Name/Use	Historic Installation Association & Building Type*	Construction Date	Condition	Integrity	Eligibility	NRHP Criteria	NRHP
55	visiting officers' quarters	staff quarters	HA--housing	1942	good	altered	Not eligible		
56	visiting officers' quarters	staff quarters	HA--housing	1942	good	altered	Not eligible		
58	visiting officers' quarters	staff quarters	HA--housing	1942	good	altered	Not eligible		
60	visiting officers' quarters	staff quarters	HA--housing	1942	good	altered	Not eligible		
62	visiting officers' quarters	staff quarters	HA--housing	1942	good	altered	Not eligible		
110	supply services admin. bldg	hospital annex	HA--administration	1943	good	altered	Not eligible		
111	public works admin. bldg.	Huntsville Arsenal Hdqtrs	HA--administration	1941	good	altered	Not eligible		
112	RASA Headquarters	admininstration building	HA--administration	1942	good	altered	Not eligible		
113	telephone exchange	communication building	HA--administration	1942	good	altered	Not eligible		
114	youth activity center	fire station	HA--infrastructure	1941	good	altered	Not eligible		
115	steam heating plant	boiler house	HA--infrastructure	1941	good	altered	Not eligible		
116	dispensary	nurses' & doctors' qtrs. & mess	HA--housing	1941	good	altered	Not eligible		
118	administration	medical detachment barracks	HA--housing	1942	good	altered	Not eligible		
122	booster pump station	booster pump station	HA--infrastructure	1941	good	unaltered	Not eligible		
3197	social & recreation bldg	maintenance shop	HA--maintenance	1943	good	altered	Not eligible		
3236	telephone switch house	telephone switch house	HA--infrastructure	1942	good	unaltered	Not eligible		
3421	provost marshall office	SMF, office building	HA--Plant #3, administration	1943	good	altered	Not eligible		
3444	warehouse	SMF inert storage warehouse	HA--Plant #3, storage	1942	fair	altered	Not eligible		
3453	admin., general purpose	SMF M-8 mixing bldg	HA--Plant #3, manufacture	1943	unknown	unknown	Not eligible		
3463	model train association bldg	magazine and paint storage	HA--Plant #3, storage	1943	good	unaltered	Not eligible		
3465	warehouse, records holding area	SMF box making bldg	HA--Plant #3, manufacture	1942	good	altered	Not eligible		
3470	training building	SMF paint & box bldg	HA--Plant #3, manufacture	1942	good	altered	Not eligible		
		SMF smoke pot							
3471	mail distribution	pack & paint bldg	HA--Plant #3, manufacture	1943	good	unaltered	Not eligible		
3474	gymnasium	SMF starter mix bldg	HA--Plant #3, manufacture	1942	good	altered	Not eligible		
3476	magazine	SMF small magazine	HA--Plant #3, storage	1942	fair	unaltered	Not eligible		
3478	storage	SMF mix building	HA--Plant #3, manufacture	1942	good	unaltered	Not eligible		
3479	human resources office & shops	SMF sleeve impregnating bldg	HA--Plant #3, manufacture	1942	good	altered	Not eligible		
3483	administration building	SMF fill and press bldg	HA--Plant #3, manufacture	1943	fair	altered	Not eligible		
3490	administration building	SMF mix & blend bldg	HA--Plant #3, manufacture	1942	DEMOLISHED	altered	Not eligible		
3491	administration building	SMF mix & blend bldg	HA--Plant #3, manufacture	1942	good	altered	Not eligible		
3492	maintenance shop	SMF mix & blend bldg	HA--Plant #3, manufacture	1943	fair	unaltered	Not eligible		
3524	magazine	IB small magazine	HA--Plant #3, storage	1942	poor	unaltered	Not eligible		
3525	magazine	IB small magazine	HA--Plant #3, storage	1942	fair	unaltered	Not eligible		
3531	classroom	IB first fire mix building	HA--Plant #3, manufacture	1942	good	altered	Not eligible		
3542	shop building	IB & SMF assembly & pack bldg	HA--Plant #3, manufacture	1942	good	altered	Not eligible		
3543	vet facility	IB & SMF assembly & pack change house	HA--Plant #3, manufacture	1943	good	altered	Not eligible		
3549	classroom/lab	IB & SMF screening & proportioning building	HA--Plant #3, manufacture	1942	good	altered	Not eligible		
3550	office building	IB & SMF screening & proportioning change house	HA--Plant #3, manufacture	1942	good	altered	Not eligible		
3551		IB magazine	HA--Plant #3, storage	1942	D	altered	Not eligible		

Building Number	Current Name/Use	Historic Name/Use	Historic Installation Association & Building Type*	Construction Date	Condition	Integrity	Eligibility	NRHP Criteria	NRHP
3553		IB & SMF mix, screening & proportioning building	HA--Plant #3, manufacture	1942	DEMOLISHED	altered	Not eligible		
3554	ammunition renovation	IB & SMF dry starter building	HA--Plant #3, manufacture	1942	good	altered	Not eligible		
3555		IB & SMF mix building	HA--Plant #3, manufacture	1942	DEMOLISHED	altered	Not eligible		
3557		IB & SMF grenade filling line							
		change house	HA--Plant #3, manufacture	1943	DEMOLISHED	altered	Not eligible		
3559	Cub Scout building	IB & SMF fill & press change house	HA--Plant #3, manufacture	1942	good	altered	Not eligible		
S3559	unknown	IB & SMF change house	HA--Plant #3, manufacture	c. 1942	unknown	unknown	Not eligible		
3560		IB & SMF starter cup filling &							
3563		drying building	HA--Plant #3, manufacture	1942	DEMOLISHED	altered	Not eligible		
		IB & SMF assembly & pack building	HA--Plant #3, manufacture	1943	DEMOLISHED	altered	Not eligible		
3564		IB & SMF assembly & pack							
		building	HA--Plant #3, manufacture	1943	DEMOLISHED	altered	Not eligible		
3565		IB & SMF assembly & pack change house	HA--Plant #3, manufacture	1942	DEMOLISHED	altered	Not eligible		
3568		SMF smoke pot fill & press bldg	HA--Plant #3, manufacture	1943	DEMOLISHED	altered	Not eligible		
3613	warehouse	IB warehouse	HA--Plant #3, storage	1945	fair	altered	Not eligible		
3614	warehouse	IB warehouse	HA--Plant #3, storage	1942	good	altered	Not eligible		
3615	arts & crafts bldg	warehouse	HA--Plant #3, storage	1942	fair	altered	Not eligible		
S3616	warehouse	IB warehouse	HA--Plant #3, storage	1942	fair	altered	Not eligible		
S3617	auto crafts shop	IB warehouse	HA--Plant #3, storage	1942	good	altered	Not eligible		
3618	warehouse	warehouse	HA--Plant #3, storage	1942	good	altered	Not eligible		
3619	office building	warehouse	HA--Plant #3, storage	1942	good	altered	Not eligible		
3622	lunchroom	oil storage & dispensing	HA--Plant #3, maintenance	1943	good	unaltered	Not eligible		
3623	administration building	machine shop	HA--Plant #3, maintenance	1943	good	altered	Not eligible		
3624	steam plant	boiler house	HA--Plant #3, infrastructure	1942	fair	altered	Not eligible		
3627	motor pool bldg, shop, & firehouse	fire station & weather station	HA--Plant #3, infrastructure	1942	fair	altered	Not eligible		
S3629	office building	air compressor building	HA--Plant #3, infrastructure	1943	fair	altered	Not eligible		
3631	vehicle maintenance	SMF motor repair bldg	HA--Plant #3, maintenance	1942	good	altered	Not eligible		
3632	warehouse	SMF warehouse	HA--Plant #3, storage	1942	good	unaltered	Not eligible		
3633	maintenance shop	SMF warehouse	HA--Plant #3, storage	1942	good	altered	Not eligible		
3634	vehicle maintenance	SMF warehouse	HA--Plant #3, storage	1943	good	unaltered	Not eligible		
3635	vehicle maintenance	SMF warehouse	HA--Plant #3, storage	1943	good	unaltered	Not eligible		
3636	maintenance shop	SMF warehouse	HA--Plant #3, storage	1943	good	unaltered	Not eligible		
3637		SMF small magazine	HA--Plant #3, storage	1942	D	altered	Not eligible		
3638	storage	SMF small magazine	HA--Plant #3, storage	1942	good	unaltered	Not eligible		
3639	fuel station	SMF gas station	HA--Plant #3, maintenance	1942	good	unaltered	Not eligible		
3640		SMF starter mix bldg	HA--Plant #3, manufacture	1942	D	altered	Not eligible		
3641	records holding building	SMF sleeve impregnating bldg	HA--Plant #3, manufacture	1942	good	unaltered	Not eligible		
3642		SMF starter mix bldg	HA--Plant #3, manufacture	1942	DEMOLISHED	altered	Not eligible		

Building Number	Current Name/Use	Historic Name/Use	Historic Installation Association & Building Type*	Construction Date	Condition	Integrity	Eligibility	NRHP Criteria	NRHP
3643		SMF change house	HA--Plant #3, manufacture	1942	D	altered	Not eligible		
3647		SMF mix & blend control house	HA--Plant #3, manufacture	1942	D	altered	Not eligible		
3648	post office	SMF fill & press bldg	HA--Plant #3, manufacture	1942	good	altered	Not eligible		
3649		SMF fill & press bldg	HA--Plant #3, manufacture	1942	D	altered	Not eligible		
3650		SMF smoke pot fill & press	HA--Plant #3, manufacture	1942	D	altered	Not eligible		
3651	javelin project building	SMF warehouse	HA--Plant #3, storage	1942	good	altered	Not eligible		
3652	warehouse	SMF warehouse	HA--Plant #3, storage	c. 1942	good	unaltered	Not eligible		
3653	warehouse	SMF painting, packing, & assembly bldg	HA--Plant #3, manufacture	c. 1942	good	unaltered	Not eligible		
3654	storage	magazine	HA--Plant #3, storage	1943	good	unaltered	Not eligible		
T3655	office building	office building	HA--Plant #3, administration	1943	poor	moved	Not eligible		
3656		SMF garage & tool room	HA--Plant #3, maintenance	1942	D	altered	Not eligible		
3657		change house	HA--Plant #3, manufacture	1943	D	altered	Not eligible		
3660		IB & SMF production bldg	HA--Plant #3, manufacture	1942	D	altered	Not eligible		
3664	dispatch office	motor maintenance	HA--Plant #3, maintenance	1943	good	altered	Not eligible		
3775	shop building	CN-DM warehouse	HA--Plant #3, storage	1943	good	altered	Not eligible		
3776	unknown	CN-DM paint spray house & storage	HA--Plant #3, manufacture	c. 1942	good	altered	Not eligible		
3777	office building	CN-DM warehouse	HA--Plant #3, storage	1943	good	altered	Not eligible		
3779	paint spray shop	CN-DM magazine	HA--Plant #3, storage	c. 1943	good	altered	Not eligible		
3780		CN-DM assembly & packing bldg	HA--Plant #3, manufacture	1943	DEMOLISHED	altered	Not eligible		
3781	ADPE maintenance	CN-DM change house	HA--Plant #3, manufacture	1943	good	altered	Not eligible		
3784	paint storage building	CN-DM mixing building	HA--Plant #3, manufacture	1943	good	altered	Not eligible		
3785		CN-DM magazine	HA--Plant #3, storage	1943	D	altered	Not eligible		
3788		CN-DM black powder magazine	HA--Plant #3, storage	1943	D	altered	Not eligible		
3789	paint storage building	CN-DM fuze magazine	HA--Plant #3, storage	1943	good	unaltered	Not eligible		
3790	storage	CN-DM maintenance shop	HA--Plant #3, maintenance	1943	good	unaltered	Not eligible		
3796	primary substation #2	primary substation #2	HA--infrastructure	1942	fair	unaltered	Not eligible		
4381	administration & laboratory solvent storage	office & lockers	HA--Plant #1, administration	1942	good	altered	Not eligible		
4424	fire station #1	administration & plant area #1 fire station	HA--Plant #1, administration	1942	good	altered	Not eligible		
4496	warehouse	chemical storage warehouse	HA--Plant #1, storage	1942	good	altered	Not eligible		
4497	threat management office and warehouse	chemical storage warehouse	HA--Plant #1, storage	1942	good	altered	Not eligible		
4637	abandoned	sewage treatment plant	HA--Plant #1, infrastructure	1942	fair	unaltered	Not eligible		
4722	ADP building	warehouse	HA--Plant #1, storage	1941	fair	altered	Not eligible		
4725	steam plant	boiler house	HA--Plant #1, infrastructure	1942	good	altered	Not eligible		
T4809		airport office building	HA--administration	1942	DEMOLISHED	altered	Not eligible		
T5285		substation control house	HA--infrastructure	c. 1946	D	altered	Not eligible		
5412	shop building	maintenance shop	HA--Plant #2, maintenance	1942	good	altered	Not eligible		
5414	facility engineer utility bldg	fire station	HA--Plant #2, infrastructure	1942	fair	altered	Not eligible		
5415	warehouse	inert storage warehouse	HA--Plant #2, storage	1943	fair	altered	Not eligible		
5420	logistics directorate	control analysis lab	HA--Plant #2, manufacture	1943	good	altered	Not eligible		
5421	lab	office and lockers	HA--Plant #2, administration	1942	fair	altered	Not eligible		
5423	warehouse	inert storage warehouse	HA--Plant #2, storage	1943	fair	altered	Not eligible		

Building Number	Current Name/Use	Historic Name/Use	Historic Installation Association & Building Type*	Construction Date	Condition	Integrity	Eligibility	NRHP Criteria	NRHP
5424	warehouse	warehouse	HA--Plant #2, storage	1943	fair	altered	Not eligible		
5425	administration building	warehouse	HA--Plant #2, storage	1942	good	unaltered	Not eligible		
5429	unknown	Lewisite? manufacturing bldg	HA--Plant #2, manufacturing	1942	good	altered	Not eligible		
5432	lab	Lewisite? sulfur monochloride bldg	HA--Plant #2, manufacture	1942	good	altered	Not eligible		
5436	warehouse	extension warehouse	HA--Plant #2, storage	1943	good	altered	Not eligible		
5437	lab	extension warehouse	HA--Plant #2, storage	1943	good	altered	Not eligible		
5451		office and locker bldg	HA--Plant #2, administration	1942	D	altered	Not eligible		
5452	lab	Lewisite? manufacturing bldg	HA--Plant #2, manufacture	1943	fair	altered	Not eligible		
5458	lab	Lewisite? acetylene scrubber bldg	HA--Plant #2, manufacture	1942	good	unaltered	Not eligible		
5480	unknown	inert storage warehouse	HA--Plant #2, storage	1943	good	unaltered	Not eligible		
5485	unknown	inert storage warehouse	HA--Plant #2, storage	1943	good	unaltered	Not eligible		
5487	warehouse	inert storage warehouse	HA--Plant #2, storage	1943	fair	altered	Not eligible		
5488	warehouse	inert storage warehouse	HA--Plant #2, storage	1943	fair	altered	Not eligible		
5489	warehouse	inert storage warehouse	HA--Plant #2, storage	1943	fair	altered	Not eligible		
5561	ICY towers	CI, ICY Towers	HA--Plant #2, manufacture	1943	good	unaltered	Eligible	A & C	military/industry/architecture
5562	compressor	CI, compressor	HA--Plant #2, manufacture	1943	good	unaltered	Eligible	A & C	military/industry/architecture
5563	decomposition building	CI, decomposition building	HA--Plant #2, manufacture	1943	good	unaltered	Eligible	A & C	military/industry/architecture
5564	water compressor & furnace	CI, hydrogen building	HA--Plant #2, manufacture	1943	good	unaltered	Eligible	A & C	military/industry/architecture
5565	administration building	CI, office	HA--Plant #2, administration	1943	good	unaltered	Eligible	A & C	military/industry/architecture
5566	iron preparation bldg	CI, iron preparation bldg	HA--Plant #2, manufacture	1943	good	unaltered	Eligible	A & C	military/industry/architecture
5567	CO generating & coke storage	CI, CO generating	HA--Plant #2, manufacture	1943	good	unaltered	Eligible	A & C	military/industry/architecture
5572	fire hose house	CI, CO generating	HA--Plant #2, manufacture	1943	good	unaltered	Eligible	A & C	military/industry/architecture
5577	warehouse	TC drum loading building	HA--Plant #2, manufacture	1943	good	altered	Not eligible		
5631	storage tank	storage tank	HA--Plant #2, storage	1942	good	unaltered	Not eligible		
T5655	field office	ethylene generator building	HA--Plant #2, manufacture	1943	good	unaltered	Not eligible		
5661	unknown	Mustard gas, H reactor	HA--Plant #2, manufacture	1942	good	unaltered	Eligible	A & C	military/industry/architecture
5662	planning & drafting bldg	Mustard gas, sulfur monochloride bldg	HA--Plant #2, manufacture	1942	good	unaltered	Eligible	A & C	military/industry/architecture
5663	youth sports	Mustard gas ethylene generator building	HA--Plant #2, manufacture	1943	good	unaltered	Eligible	A & C	military/industry/architecture
5664	resource management & technical engineering	Mustard gas scrubber	HA--Plant #2, manufacture	1944	good	altered	Not eligible		
5666	storage	Mustard gas HS scrubber & disposal reactor	HA--Plant #2, manufacture	1942	good	unaltered	Eligible	A & C	military/industry/architecture
5668	warehouse	chlorine warehouse	HA--Plant #2, storage	1942	good	unaltered	Eligible	A & C	military/industry/architecture
5669	warehouse	chlorine warehouse	HA--Plant #2, storage	1942	good	unaltered	Eligible	A & C	military/industry/architecture
5670	warehouse	chlorine warehouse	HA--Plant #2, storage	1942	good	unaltered	Eligible	A & C	military/industry/architecture
5671	office/shop for Pershing project	Mustard gas (H) reactor	HA--Plant #2, manufacture	1942	good	unaltered	Eligible	A & C	military/industry/architecture
5672	storage	Mustard Gas sulfur monochloride bldg	HA--Plant #2, manufacture	1942	good	unaltered	Eligible	A & C	military/industry/architecture
5673	storage	Mustard gas ethylene generator building	HA--Plant #2, manufacture	1942	good	unaltered	Eligible	A & C	military/industry/architecture
5675		Phosgene, CO plant	HA--Plant #2, manufacture	1942	D	altered	Not eligible		
5676		Phosgene, catalyzer building	HA--Plant #2, manufacture	1942	D	altered	Not eligible		
5678	administration building	coke storage warehouse	HA--Plant #2, storage	1942	good	altered	Not eligible		
5681	administration building	incendiary oil bomb plant	HA--Plant #2, manufacture	1942	good	altered	Not eligible		

Building Number	Current Name/Use	Historic Name/Use	Historic Installation Association & Building Type*	Construction Date	Condition	Integrity	Eligibility	NRHP Criteria	NRHP
5685	warehouse	warehouse	HA--Plant #2, storage	1943	fair	unaltered	Not eligible		
5687	administration building	warehouse	HA--Plant #2, storage	1943	good	altered	Not eligible		
5688	reproduction	inert storage warehouse	HA-Plant #2, storage	1942	good	altered	Not eligible		
5689	bulk oil pump station	gasoline pump house	HA--Plant #2, infrastructure	1943	fair	unaltered	Not eligible		
5690	mogas control valve shed	gas loading & pump station	HA--Plant #2, maintenance	c. 1940s	good	unaltered	Not eligible		
5691	storage tank	storage tank	HA--Plant #2, storage	c. 1940s	good	unaltered	Not eligible		
5692	bulk oil storage tank	bulk fuel & alcohol storage tank	HA--Plant #2, storage	1943	good	unaltered	Not eligible		
5693	bulk oil storage tank	bulk fuel & alcohol storage tank	HA--Plant #2, storage	1943	good	unaltered	Not eligible		
5694	bulk oil storage tank	bulk alcohol storage tank	HA--Plant #2, storage	1943	good	unaltered	Not eligible		
5695	bulk oil storage tank	bulk alcohol storage tank	HA--Plant #2, storage	1943	good	unaltered	Not eligible		
5696	bulk oil storage tank	bulk alcohol storage tank	HA--Plant #2, storage	1943	good	unaltered	Not eligible		
5697	bulk oil storage tank	bulk fuel & alcohol storage tank	HA--Plant #2, storage	1943	good	unaltered	Not eligible		
5698	bulk oil storage tank	bulk fuel & alcohol storage tank	HA--Plant #2, storage	1943	good	unaltered	Not eligible		
5699	bulk oil storage tank	bulk fuel & alcohol storage tank	HA--Plant #2, storage	1943	good	unaltered	Not eligible		
7103	material facility	engine house machine shop & auto repair	RSA--maintenance	1941	good	altered	Not eligible		
7104	modifications shop	utilities & carpenter shop	RSA--maintenance	1941	good	altered	Not eligible		
7105	steam plant	boiler house	RSA--infrastructure	1942	good	unaltered	Not eligible		
7106	janitorial	electrical equipment	RSA--infrastructure	1945	good	unaltered	Not eligible		
S7107	office	gas station & bulk storage	RSA--maintenance	1945	D	altered	Not eligible		
7108	office & locker room	paint & storage	RSA--storage	1942	good	altered	Not eligible		
7111	propulsion lab annex	communication building	RSA--administration	1942	good	altered	Not eligible		
7112	shop building	unknown	RSA--unknown	1942	good	altered	Not eligible		
7115		laundry	RSA--infrastructure	1942	D	altered	Not eligible		
S7118		medical detachment barracks	RSA--housing	1943	D	altered	Not eligible		
7119	janitorial	generator station	RSA--infrastructure	1942	good	altered	Not eligible		
7121	FBI hazardous devises training area	officers' quarters	RSA--housing	1942	fair	altered	Not eligible		
7122	FBI hazardous devises training area	officers' quarters	RSA--housing	1942	fair	altered	Not eligible		
7123	FBI hazardous devises training area	officers' quarters	RSA--housing	1942	fair	altered	Not eligible		
7124	FBI hazardous devises training area	officers' quarters	RSA--housing	1942	fair	altered	Not eligible		
7125	FBI hazardous devises training area	officers' quarters	RSA--housing	1942	fair	altered	Not eligible		
7126	FBI hazardous devises training area	officers' quarters	RSA--housing	1946	fair	altered	Not eligible		
7127	FBI hazardous devises training area	officers' quarters	RSA--housing	1946	fair	altered	Not eligible		
7128	FBI hazardous devises training area	officers' quarters	RSA--housing	1946	fair	altered	Not eligible		
7129	FBI hazardous devises training area	officers' quarters	RSA--housing	1946	fair	altered	Not eligible		
7130	FBI hazardous devises training area	officers' quarters	RSA--housing	1946	fair	altered	Not eligible		
S7132		unknown	RSA--unknown	c. 1940s	D	altered	Not eligible		
7134	office	quarters	RSA--housing	1835	good	moved	Not eligible		

Building Number	Current Name/Use	Historic Name/Use	Historic Installation Association & Building Type*	Construction Date	Condition	Integrity	Eligibility	NRHP Criteria	NRHP
7142	grass cutting equip. storage	maintenance shop	RSA--maintenance	c. 1940s	fair	unaltered	Not eligible		
17175	unknown	paint & oil storage	RSA--storage	1945	good	unaltered	Not eligible		
7201	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7202	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7203	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7204	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7205	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7206	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7207	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7211	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7212	missile assembly	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7213	missile assembly	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7214	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7215	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7216	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7217	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7221	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7222	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7223	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7224	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7225	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7226	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7227	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7231	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7232	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7233	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7234	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7235	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7236	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7237	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7241	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7242	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7243	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7244	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7245	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7246	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7247	warehouse	ammunition magazine	RSA--storage	1941	good	unaltered	Not eligible		
7261	warehouse	finished fuze & primer storage building	RSA--storage	1941	good	unaltered	Not eligible		
7262	warehouse	finished fuze & primer storage building	RSA--storage	1941	good	unaltered	Not eligible		
7263	warehouse	finished fuze & primer storage building	RSA--storage	1941	good	unaltered	Not eligible		
7264	warehouse	finished fuze & primer storage building	RSA--storage	1941	good	unaltered	Not eligible		
7265	warehouse	finished fuze & primer storage building	RSA--storage	1941	good	unaltered	Not eligible		

Building Number	Current Name/Use	Historic Name/Use	Historic Installation Association & Building Type*	Construction Date	Condition	Integrity	Eligibility	NRHP Criteria	NRHP
7266	warehouse	finished fuze & primer storage building	RSA--storage	1941	good	unaltered	Not eligible		
T7292	guard building	guard building/sentry box	RSA--administration	1943	fair	unaltered	Not eligible		
7301-7307	igloo 60 ft	igloo 60 ft	RSA--storage	c. 1942	good	unaltered	Not eligible		
7311-7318	igloo 60 ft	igloo 60 ft	RSA--storage	c. 1942	good	unaltered	Not eligible		
7321	igloo 40 ft	igloo 40ft	RSA--storage	1942	good	unaltered	Not eligible		
7322-7325	igloo 80 ft	igloo 80 ft	RSA--storage	1942	good	unaltered	Not eligible		
7326-7327	igloo 40 ft	igloo 40ft	RSA--storage	1942	good	unaltered	Not eligible		
7331-7335	igloo 40 ft	igloo 40ft	RSA--storage	1942	good	unaltered	Not eligible		
7341-7343	igloo 40 ft	igloo 40ft	RSA--storage	1942	good	unaltered	Not eligible		
7364	motor conditioning	Line #1; TNT screening	RSA--manufacture	1945	good	altered	Not eligible		
7367	abandoned	vacuum pump house	RSA--manufacture	1945	fair	unaltered	Not eligible		
7368	motor producer bldg	Line #1; TNT & Teteryl screening	RSA--manufacture	1942	good	altered	Not eligible		
7369	liner prep	Line #1, change house	RSA--manufacture	1942	good	altered	Not eligible		
7373	fix and clean bldg	Line #2; teteryl screening	RSA--manufacture	1942	fair	altered	Not eligible		
7375		Line #1; static function test	RSA--manufacture	1942	D	altered	Not eligible		
7403	warehouse	inert storage warehouse	RSA--storage	1941	good	altered	Not eligible		
7404	warehouse	inert storage warehouse	RSA--storage	1941	good	altered	Not eligible		
7405	warehouse	inert storage warehouse	RSA--storage	1941	good	altered	Not eligible		
7406	warehouse	inert storage warehouse	RSA--storage	1941	good	altered	Not eligible		
7407	warehouse	inert storage warehouse	RSA--storage	1941	good	unaltered	Not eligible		
7413	warehouse	inert storage warehouse	RSA--storage	1941	good	altered	Not eligible		
7414	warehouse	inert storage warehouse	RSA--storage	1941	good	altered	Not eligible		
7415	warehouse	inert storage warehouse	RSA--storage	1941	good	altered	Not eligible		
7416	warehouse	inert storage warehouse	RSA--storage	1941	good	altered	Not eligible		
7417	warehouse	inert storage warehouse	RSA--storage	1941	good	unaltered	Not eligible		
7420	warehouse	inert storage warehouse	RSA--storage	1941	good	unaltered	Not eligible		
7421	warehouse	inert storage warehouse	RSA--storage	1941	good	altered	Not eligible		
7422	warehouse	inert storage warehouse	RSA--storage	1941	good	altered	Not eligible		
7423	warehouse	inert storage warehouse	RSA--storage	1941	good	altered	Not eligible		
7424	warehouse	inert storage warehouse	RSA--storage	1941	good	altered	Not eligible		
7425	warehouse	inert storage warehouse	RSA--storage	1941	good	altered	Not eligible		
7426	warehouse	inert storage warehouse	RSA--storage	1941	good	altered	Not eligible		
7427	warehouse	inert storage warehouse	RSA--storage	1941	good	unaltered	Not eligible		
7430	warehouse	inert storage warehouse	RSA--storage	1941	good	unaltered	Not eligible		
7431	warehouse	inert storage warehouse	RSA--storage	1941	good	altered	Not eligible		
7432	warehouse	inert storage warehouse	RSA--storage	1941	good	altered	Not eligible		
7433	warehouse	inert storage warehouse	RSA--storage	1941	good	altered	Not eligible		
7434	warehouse	inert storage warehouse	RSA--storage	1941	good	altered	Not eligible		
7435	warehouse	inert storage warehouse	RSA--storage	1941	good	altered	Not eligible		
7436	warehouse	inert storage warehouse	RSA--storage	1941	good	altered	Not eligible		



Building Number	Current Name/Use	Historic Name/Use	Historic Installation Association & Building Type*	Construction Date	Condition	Integrity	Eligibility	NRHP Criteria	NRHP
7437	warehouse	inert storage warehouse	RSA--storage	1941	good	unaltered	Not eligible		
7440	warehouse	inert storage warehouse	RSA--storage	1941	good	unaltered	Not eligible		
7442	administration building	inspection, testing & shell cleaning bldg	RSA--manufacture	1941	good	altered	Not eligible		
7443	warehouse	warehouse	RSA--storage	1941	good	unaltered	Not eligible		
7444	warehouse	warehouse	RSA--storage	1941	good	altered	Not eligible		
7445	warehouse	warehouse	RSA--storage	1941	good	unaltered	Not eligible		
7446	administration building	inert storage warehouse	RSA--storage	1941	good	altered	Not eligible		
7471	office building	administration office & change house	RSA--administration	1944	good	altered	Not eligible		
7529	magazine	elevated service magazine	RSA, Line #3--storage	1942	fair	unaltered	Eligible	A & C	military/industry/architecture
7530	magazine	elevated service magazine	RSA, Line #3--storage	1942	fair	unaltered	Eligible	A & C	military/industry/architecture
7531	magazine	elevated service magazine	RSA, Line #3--storage	1942	fair	unaltered	Eligible	A & C	military/industry/architecture
7551	inert storage	chemical shell receiving bldg	RSA, Line #3--manufacture	1942	fair	unaltered	Eligible	A & C	military/industry/architecture
7551a	unknown	chemical shell receiving bldg	RSA, Line #3--manufacture	c. 1942	fair	unaltered	Eligible	A & C	military/industry/architecture
7552	condition building	standard service magazine	RSA, Line #3--storage	1942	fair	unaltered	Eligible	A & C	military/industry/architecture
7553	unknown	assembly, packing and shipping bldg	RSA, Line #3--manufacture	c. 1942	good	altered	Eligible	A & C	military/industry/architecture
7554	missile assembly & testing	assembly, packing and shipping bldg	RSA, Line #3--manufacture	1943	good	altered	Eligible	A & C	military/industry/architecture
7555	lab solvent powder prod.	propellant change building	RSA, Line #3--manufacture	1942	D	altered	Not eligible		
7556	warehouse	primer service building	RSA, Line #3--manufacture	1942	poor	unaltered	Eligible	A & C	military/industry/architecture
7557	storage	lockers & refrigeration unit	RSA, Line #3--manufacture	1942	fair	unaltered	Eligible	A & C	military/industry/architecture
7558	line office	powder service building/office	RSA, Line #3--manufacture	1942	fair	unaltered	Eligible	A & C	military/industry/architecture
T7561		lockers & change house	RSA, Line #3--manufacture	1942	D	altered	Not eligible		
7565	control building	unknown	RSA, Line #3--unknown	1945	D	altered	Not eligible		
7567	control building	unknown	RSA, Line #3--unknown	c. 1940s	good	altered	Eligible	A & C	military/industry/architecture
7569		remelt munitions building	RSA, Line #3--manufacture	1945	D	altered	Not eligible		
7571	shop & lab	chemical shell receiving bldg	RSA, Line #4--manufacture	1942	fair	altered	Not eligible		
7572		standard service magazine	RSA, Line #4--storage	1942	D	altered	Not eligible		
7574		loading and assembly, packing and shipping bldg	RSA, Line #4--manufacture	1942	DEMOLISHED	altered	Not eligible		
7575	storage	propellant charge building	RSA, Line #4--manufacture	1942	good	altered	Not eligible		
7578	storage	storage	RSA, Line #4--storage	c. 1945	good	altered	Not eligible		
7579	steam heat plant	boiler house	RSA, infrastructure	1942	good	unaltered	Not eligible		
7581	case prep building	change house	RSA, Line #4--manufacture	1941	good	altered	Not eligible		
7585	conditioning building	unknown	RSA, Line #3--unknown	1945	fair	altered	Eligible	A & C	military/industry/architecture
7586	sewage lift station	sewage lift station	RSA--infrastructure	1946	unknown	unknown	Not eligible		
7587	test cell	unknown	RSA, Line #3--unknown	c. 1940s	poor	altered	Eligible	A & C	military/industry/architecture
S7600	inert storage	unknown	RSA, Line #5--unknown	c. 1940s	fair	altered	Not eligible		
7601	pilot line service building	155 mm loading/assembly	RSA, Line #5--manufacture	1942	fair	altered	Not eligible		
7602		burster service magazine	RSA, Line #5--storage	1942	D	altered	Not eligible		
7603		155mm loading/assembly	RSA, Line #5--manufacture	1942	D	altered	Not eligible		
7604		boiler house & paint storage	RSA, Line #5--infrastructure	1942	D	altered	Not eligible		
T7605		line office	RSA, Line #5--administration	1942	D	altered	Not eligible		
7606		change house	RSA, Line #5--manufacture	1942	D	altered	Not eligible		
7607		walkway	RSA, Line #5--manufacture	c. 1942	D	altered	Not eligible		

Building Number	Current Name/Use	Historic Name/Use	Historic Installation Association & Building Type*	Construction Date	Condition	Integrity	Eligibility	NRHP Criteria	NRHP
7608		loading platform & storage	RSA, Line #5--manufacture	1942	D	altered	Not eligible		
7609	welding shop	paint storage & ramp	RSA, Line #5--storage	1945	good	altered	Not eligible		
7610	chemical storage	burster service magazine	RSA, Line #5--storage	1942	good	unaltered	Not eligible		
7614		unknown	RSA, Line #5--unknown	c. 1940s	D	altered	Not eligible		
7615		vacuum pump house	RSA, Line #5--manufacture	c. 1940s	D	altered	Not eligible		
7616		unknown	RSA, Line #5--unknown	c. 1940s	D	altered	Not eligible		
7617		unknown	RSA, Line #5--unknown	c. 1940s	D	altered	Not eligible		
7618		unknown	RSA, Line #5--unknown	c. 1940s	D	altered	Not eligible		
7621		rest house	RSA, manufacture	c. 1940s	D	altered	Not eligible		
7622		rest house	RSA, manufacture	c. 1940s	D	altered	Not eligible		
7623		rest house	RSA, manufacture	c. 1940s	D	altered	Not eligible		
7624	storage	rest house	RSA, manufacture	c. 1940s	good	unaltered	Not eligible		
7634		unknown	RSA, unknown	c. 1940s	D	altered	Not eligible		
7640		unknown	RSA, unknown	c. 1940s	D	altered	Not eligible		
7641		unknown	RSA, unknown	c. 1940s	D	altered	Not eligible		
7642		unknown	RSA, unknown	c. 1940s	D	altered	Not eligible		
7643		paint & spray building	RSA, manufacture	c. 1940s	D	altered	Not eligible		
7644		unknown	RSA, unknown	c. 1940s	D	altered	Not eligible		
7645		unknown	RSA, unknown	c. 1940s	D	altered	Not eligible		
T7648		guard house	RSA, administration	c. 1940s	D	altered	Not eligible		
T7649	guard house	guard house	RSA, administration	c. 1940s	unknown	unaltered	Not eligible		
7651		service magazine & rest hse	RSA, Line #1--manufacture	1941	D	altered	Not eligible		
7652		tetryl screening & blending	RSA, Line #1--manufacture	1941	D	altered	Not eligible		
7653		service magazine & rest hse	RSA, Line #1--manufacture	1941	D	altered	Not eligible		
7654		tetryl pelleting	RSA, Line #1--manufacture	1942	D	altered	Not eligible		
7655		unknown	RSA, Line #1--unknown	c. 1940s	D	altered	Not eligible		
7656		percholate building	RSA, Line #1--manufacture	c. 1940s	D	altered	Not eligible		
7657		vacuum pump house	RSA, Line #1--manufacture	1941	D	altered	Not eligible		
7658		percholate building	RSA, Line #1--manufacture	c. 1940s	D	altered	Not eligible		
7659		vacuum pump house	RSA, Line #1--manufacture	1941	D	altered	Not eligible		
7662		service magazine & rest hse	RSA, Line #1--manufacture	1941	D	altered	Not eligible		
7663		burster charge loading & assembly building	RSA, Line #1--manufacture	1941	DEMOLISHED	altered	Not eligible		
7664		unknown	RSA, Line #1--unknown	c. 1940s	D	altered	Not eligible		
7665		unknown	RSA, Line #1--unknown	c. 1940s	D	altered	Not eligible		
7667		change house	RSA, Line #1--manufacture	1941	D	altered	Not eligible		
7668	steam heat plant	boiler house	RSA, Line #1--infrastructure	1942	D	altered	Not eligible		
T7670	guard house	guard house	RSA, administration	1943	good	unaltered	Not eligible		
7675		walkway	RSA, Line #1--manufacture	c. 1942	D	altered	Not eligible		
7675		vacuum collector building	RSA, Line #1--manufacture	c. 1942	D	altered	Not eligible		
7677		vacuum pump house	RSA, Line #1--manufacture	1942	D	altered	Not eligible		
7678		vacuum collector building	RSA, Line #1--manufacture	c. 1940s	D	altered	Not eligible		
7680		vacuum pump house	RSA, Line #1--manufacture	1942	D	altered	Not eligible		
7681		vacuum collector building	RSA, Line #1--manufacture	c. 1940s	D	altered	Not eligible		
7682		vacuum collector building	RSA, Line #1--manufacture	c. 1940s	D	altered	Not eligible		
7683		unknown	RSA, Line #1--unknown	1942	D	altered	Not eligible		

Building Number	Current Name/Use	Historic Name/Use	Historic Installation Association & Building Type*	Construction Date	Condition	Integrity	Eligibility	NRHP Criteria	NRHP
7684		unknown	RSA, Line #1--unknown	c. 1940s	D	altered	Not eligible		
7685a		unknown	RSA, Line #1--unknown	c. 1942	D	altered	Not eligible		
7685		control switch station	RSA, Line #1--manufacture	1943	D	altered	Not eligible		
T7702	traffic control building	guard house	RSA--administration	1942	good	moved	Not eligible		
7721		explosive magazine	RSA, Line #2--storage	1942	D	altered	Not eligible		
7722	paint building	tetryl screening & blending	RSA, Line #2--manufacture	1941	good	altered	Eligible	A & C	military/industry/architecture
7722a	unknown	unknown	RSA, Line #2--unknown	c. 1940s	fair	unaltered	Eligible	A & C	military/industry/architecture
7723		magazine & rest house	RSA, Line #2--manufacture	1941	D	altered	Not eligible		
7724	small motor assembly	service magazine	RSA, Line #2--storage	1942	good	altered	Eligible	A & C	military/industry/architecture
7724a	unknown	tetryl pelleting building	RSA, Line #2--manufacture	1942	good	altered	Eligible	A & C	military/industry/architecture
7725b	unknown	unknown	RSA, Line #2--unknown	1942	unknown	unknown	Eligible	A & C	military/industry/architecture
7725		service magazine & rest hse	RSA, Line #2--storage	1941	D	altered	Not eligible		
7726		pellet & pour house	RSA, Line #2--manufacture	1942	D	altered	Not eligible		
7726a1		walkway	RSA, Line #2--manufacture	1942	D	altered	Not eligible		
7726a2		walkway	RSA, Line #2--manufacture	1942	D	altered	Not eligible		
7726a3		unknown	RSA, Line #2--manufacture	1942	D	altered	Not eligible		
7726b		unknown	RSA, Line #2--unknown	c. 1940s	D	altered	Not eligible		
7726c		unknown	RSA, Line #2--unknown	c. 1940s	D	altered	Not eligible		
7726d		unknown	RSA, Line #2--unknown	c. 1940s	D	altered	Not eligible		
7726e		unknown	RSA, Line #2--unknown	c. 1940s	DEMOLISHE	altered	Not eligible		
7726f		unknown	RSA, Line #2--unknown	c. 1940s	D	altered	Not eligible		
7727	motor test facility	packing and shipping bldg	RSA, Line #2--manufacture	1941	fair	unaltered	Eligible	A & C	military/industry/architecture
7728		change bldg & bomb shelter	RSA, Line #2--manufacture	1941	D	altered	Not eligible		
7729		boiler house	RSA, Line #2--infrastructure	1941	D	altered	Not eligible		
7729a		walkway	RSA, Line #2--manufacture	c. 1941	D	altered	Not eligible		
7734		unknown	RSA, Line #2--unknown	1942	D	altered	Not eligible		
7735		vacuum pump house	RSA, Line #2--manufacture	1942	D	altered	Not eligible		
T7737	storage	storage shed	RSA, Line #2--storage	1943	good	unaltered	Eligible	A & C	military/industry/architecture
7738		tetryl screening bldg	RSA, Line #2--manufacture	1945	D	altered	Not eligible		
7739		TNT screening bldg	RSA, Line #2--manufacture	1945	D	altered	Not eligible		
T7862	gate guard house	guard house	RSA--administration	c. 1940s	good	unaltered	Not eligible		
8009		unknown	GCWD--unknown	1945	D	altered	Not eligible		
8012	administration building	quarters	GCWD--housing	c. 1920s	good	unaltered	Eligible	A, C, & D	architecture/social history
8014		police & fire station	GCWD--administration	1942	D	altered	Not eligible		
8017	boat storage	maintenance garage	GCWD--maintenace	1943	good	unaltered	Not eligible		
8019		warehouse office	GCWD--administration	1942	D	altered	Not eligible		
8020		change house	GCWD--manufacture	1942	D	altered	Not eligible		
8021	warehouse	warehouse	GCWD--storage	1943	good	unaltered	Not eligible		
8022	warehouse	warehouse	GCWD--storage	1942	good	unaltered	Not eligible		
8023	warehouse	warehouse	GCWD--storage	1942	good	unaltered	Not eligible		
8024	warehouse	warehouse	GCWD--storage	1942	good	unaltered	Not eligible		
8025	warehouse	warehouse	GCWD--storage	1942	good	unaltered	Not eligible		
8026	warehouse	warehouse	GCWD--storage	1942	good	unaltered	Not eligible		
8027	warehouse	warehouse	GCWD--storage	1942	good	unaltered	Not eligible		
8038	water treatment plant	water treatment plant	GCWD--infrastructure	1942	good	unaltered	Not eligible		
8039	low lift pump station	low lift pump station	GCWD--infrastructure	1942	good	unaltered	Not eligible		

Building Number	Current Name/Use	Historic Name/Use	Historic Installation Association & Building Type*	Construction Date	Condition	Integrity	Eligibility	NRHP Criteria	NRHP
T8040	tank shed	shed	GCWD--storage	c. 1940	fair	unaltered	Not eligible		
8041	chemical feed & settling basin	unknown water treatment building	GCWD--infrastructure	c. 1940	good	unaltered	Not eligible		
8042	control building (unknown)	unknown water treatment building	GCWD--infrastructure	1942	good	unaltered	Not eligible		
8101-8125	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8131	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8205	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8208-8214	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8216-8231	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8301-8315	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8317-8331	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8333-8375	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8377-8389	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8401-8408	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8501-8506	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8507-8508	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8511-8513	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8516	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8519-8539	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8541-8548	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8553-8556	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8558-8559	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8561-8563	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8565	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8569	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8572	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8574-8575	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8600	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8601-8644	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8646-8647	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture

Building Number	Current Name/Use	Historic Name/Use	Historic Installation Association & Building Type*	Construction Date	Condition	Integrity	Eligibility	NRHP Criteria	NRHP
8650-8652	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8700	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8701-8715	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8717-8727	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8729-8735	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8737-8761	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8785	field office	packing, shipping & receiving building	GCWD--administration	1942	good	altered	Not eligible		
8786	gas meter station steam plant	boiler house	GCWD--infrastructure	1942	unknown	unknown	Not eligible		
8856-8869	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8801-8820	unknown	large magazine	GCWD--storage	1941	poor	unaltered	Not eligible		
8821-8822	unknown	small magazine	GCWD--storage	1941	poor	unaltered	Not eligible		
8824-8827	unknown	small magazine	GCWD--storage	1941	poor	unaltered	Not eligible		
8829-8830	unknown	small magazine	GCWD--storage	1941	poor	unaltered	Not eligible		
8833-8855	unknown	small magazine	GCWD--storage	1941	poor	unaltered	Not eligible		
8901-8902	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8904-8926	igloo 81 ft	igloo 81 ft	GCWD--storage	1942	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8931-8934	igloo 81 ft	igloo 81 ft	GCWD--storage	1943	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8936-8949	igloo 81 ft	igloo 81 ft	GCWD--storage	1943	good/fair**	unaltered	Eligible	A & C	military/industry/architecture
8971		shell assembly building	RSA, Line #6--storage	1945	D	altered	Not eligible		
8972		assembly & packing building	RSA, Line #6--manufacture	1945	D	altered	Not eligible		
8973	lab and shop	shell assembly building	RSA, Line #6--manufacture	1945	good	altered	Not eligible		
8974	storage	paint storage	RSA, Line #6--storage	1945	good	unaltered	Not eligible		
8975	quiet facility	propellant weighing & storage bldg	RSA, Line #6--manufacture	1945	good	altered	Not eligible		
8977	abandoned	boiler house	RSA, Line #6--infrastructure	1945	fair	unaltered	Not eligible		
8978		change house	RSA, Line #6--manufacture	1945	D	altered	Not eligible		

\* HA--Huntsville Arsenal

RSA--Redstone Arsenal

GCWD--Gulf Chemical Warfare Depot

\*\*The igloos in the GCWD are generally in good to fair condition. There are too many to record individually, but the vast majority have faced no alterations.

## APPENDIX B – REDSTONE ARSENAL NRHP PROPERTIES

## APPENDIX B

### REDSTONE ARSENAL NRHP PROPERTIES

Building No.	Historic District (H.D.) Name	NRHP Context
110	Guided Missile Center H.D.	Cold War
111	Guided Missile Center H.D.	Cold War
112	Guided Missile Center H.D.	Cold War
116	Guided Missile Center H.D.	Cold War
118	Guided Missile Center H.D.	Cold War
4381	Individual NRHP Property	Cold War
4484	Individual NRHP Property	Cold War
4488	Individual NRHP Property	Cold War
4489	Individual NRHP Property	Cold War
4505	Individual NRHP Property	Cold War
5561	Carbonyl Iron Unit H.D.	WWII
5562	Carbonyl Iron Unit H.D.	WWII
5563	Carbonyl Iron Unit H.D.	WWII
5564	Carbonyl Iron Unit H.D.	WWII
5565	Carbonyl Iron Unit H.D.	WWII
5566	Carbonyl Iron Unit H.D.	WWII
5567	Carbonyl Iron Unit H.D.	WWII
5572	Carbonyl Iron Unit H.D.	WWII
5661	Mustard Gas H.D.	WWII
5662	Mustard Gas H.D.	WWII
5663	Mustard Gas H.D.	WWII
5666	Mustard Gas H.D.	WWII
5668	Mustard Gas H.D.	WWII
5669	Mustard Gas H.D.	WWII
5670	Mustard Gas H.D.	WWII
5671	Mustard Gas H.D.	WWII
5672	Mustard Gas H.D.	WWII
5673	Mustard Gas H.D.	WWII
7529	Redstone Arsenal Line 3 H.D.	WWII
7530	Redstone Arsenal Line 3 H.D.	WWII
7531	Redstone Arsenal Line 3 H.D.	WWII
7551	Redstone Arsenal Line 3 H.D.	WWII
7551a	Redstone Arsenal Line 3 H.D.	WWII
7552	Redstone Arsenal Line 3 H.D.	WWII
7553	Redstone Arsenal Line 3 H.D.	WWII
7554	Redstone Arsenal Line 3 H.D.	WWII
7556	Redstone Arsenal Line 3 H.D.	WWII
7557	Redstone Arsenal Line 3 H.D.	WWII
7558	Redstone Arsenal Line 3 H.D.	WWII
7567	Redstone Arsenal Line 3 H.D.	WWII



7585	Redstone Arsenal Line 3 H.D.	WWII
7587	Redstone Arsenal Line 3 H.D.	WWII
7722	Redstone Arsenal Line 2 H.D.	WWII
7722a	Redstone Arsenal Line 2 H.D.	WWII
7724	Redstone Arsenal Line 2 H.D.	WWII
7724a	Redstone Arsenal Line 2 H.D.	WWII
7724b	Redstone Arsenal Line 2 H.D.	WWII
7727	Redstone Arsenal Line 2 H.D.	WWII
T7737	Redstone Arsenal Line 2 H.D.	WWII
8012	Individual NRHP Property	Pre-Federal Period
8101-8125	GCWD Igloo Area 2 H.D.	WWII
8131	GCWD Igloo Area 2 H.D.	WWII
8205	GCWD Igloo Area 2 H.D.	WWII
8208-8214	GCWD Igloo Area 2 H.D.	WWII
8216-8231	GCWD Igloo Area 2 H.D.	WWII
8301-8315	GCWD Igloo Area 2 H.D.	WWII
8317-8331	GCWD Igloo Area 2 H.D.	WWII
8333-8375	GCWD Igloo Area 2 H.D.	WWII
8377-8389	GCWD Igloo Area 2 H.D.	WWII
8377-8389	GCWD Igloo Area 2 H.D.	WWII
8401-8408	GCWD Igloo Area 2 H.D.	WWII
8501-8506	GCWD Igloo Area 2 H.D.	WWII
8507-8508	GCWD Igloo Area 2 H.D.	WWII
8511-8513	GCWD Igloo Area 2 H.D.	WWII
8516	GCWD Igloo Area 2 H.D.	WWII
8519-8539	GCWD Igloo Area 2 H.D.	WWII
8541-8548	GCWD Igloo Area 2 H.D.	WWII
8553-8556	GCWD Igloo Area 2 H.D.	WWII
8558-8559	GCWD Igloo Area 2 H.D.	WWII
8561-8563	GCWD Igloo Area 2 H.D.	WWII
8565	GCWD Igloo Area 2 H.D.	WWII
8569	GCWD Igloo Area 2 H.D.	WWII
8572	GCWD Igloo Area 2 H.D.	WWII
8574-8575	GCWD Igloo Area 2 H.D.	WWII
8600	GCWD Igloo Area 2 H.D.	WWII
8601-8644	GCWD Igloo Area 2 H.D.	WWII
8646-8647	GCWD Igloo Area 2 H.D.	WWII
8650-8652	GCWD Igloo Area 2 H.D.	WWII
8700	GCWD Igloo Area 2 H.D.	WWII
8701-8715	GCWD Igloo Area 2 H.D.	WWII
8717-8727	GCWD Igloo Area 2 H.D.	WWII
8729-8735	GCWD Igloo Area 2 H.D.	WWII
8737-8761	GCWD Igloo Area 2 H.D.	WWII
8856-8869	GCWD Igloo Area 2 H.D.	WWII
8901-8902	GCWD Igloo Area 2 H.D.	WWII
8904-8926	GCWD Igloo Area 2 H.D.	WWII

8931-8934	GCWD Igloo Area 2 H.D.	WWII
8936-8949	GCWD Igloo Area 2 H.D.	WWII
8950-8967	GCWD Igloo Area 2 H.D.	WWII